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Origins of Sockeye Salmon in East Side Bristol Bay Fisheries in 1990 Based on Linear Discriminant Function Analysis of Scale Patterns

by

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ABSTRACT

Stock composition of the 1990 commercial sockeye salmon *Oncorhynchus nerka* harvests in Naknek-Kvichak, Egegik, and Ugashik Districts, Bristol Bay, Alaska, were estimated with scale pattern analyses and age composition. Scale measurements from age-2.2 and -2.3 sockeye salmon escapement samples were used to build discriminant functions which allowed the stock composition of these age groups in the commercial catch to be estimated. Stock origins for other age groups were estimated by combining age-2.2 and -2.3 scale pattern analyses with escapement age compositions. Most sockeye salmon harvested had originated from rivers within the fishing district; however, harvest of outside stocks occurred in every district. Of the estimated 17,126,625 sockeye salmon caught in Naknek-Kvichak District, 52% were from Kvichak River, 40% from Naknek River, 3% from Egegik River, and 5% from Ugashik River. The estimated 10,086,953 sockeye salmon caught in Egegik District were composed of the following stocks: 78% Egegik, 17% Kvichak, 3% Naknek, and 2% Ugashik Rivers. The estimated Ugashik District harvest of 2,144,268 sockeye salmon were 74% Ugashik River, 5% Kvichak River, < 1% Naknek River, and 21% Egegik River origin. Estimated exploitation rates were 60% for Kvichak River, 78% for Naknek and Ugashik Rivers, and 80% for Egegik River stocks.

KEY WORDS: Sockeye salmon *Oncorhynchus nerka*, Bristol Bay, scale pattern analysis, linear discriminant analysis, stock composition, exploitation rate

INTRODUCTION

To facilitate discreet stock management, the Bristol Bay sockeye salmon *Oncorhynchus nerka* fishery is restricted to districts located near the mouths of major spawning streams (Figure 1). However, the close proximity of these spawning streams and annual variation in migratory routes still results in stock mixing in the fisheries.

The Bristol Bay Management Area is divided into two general fisheries, the East and West Side. The East Side fishery is composed of Naknek-Kvichak, Egegik, and Ugashik Districts (Figure 1); the West Side fishery includes Nushagak and Togiak Districts. Naknek-Kvichak District is further subdivided into Naknek and Kvichak Sections.

From 1956 to present, harvest stock composition estimates from Naknek-Kvichak District were based on escapement age composition estimates from Kvichak, Alagnak (Branch), and Naknek Rivers, and total runs of sockeye salmon to Egegik and Ugashik Rivers were estimated by adding the district catch to the district escapement. This standard method assumes (1) that all fish harvested in a district were returning to rivers within that district, and (2) equal exploitation among stocks. Complete results of the standard method have been summarized and published in separate reports (Stratton 1990, 1991). Bernard (1983) evaluated the biases inherent with this procedure.

Decreased catches of sockeye salmon in Naknek-Kvichak District in 1985 and 1986 prompted concern that these fish were being intercepted in Egegik and Ugashik Districts where catches were large (Figure 2). Straty (1975), after conducting a tagging study from 1955 to 1957, concluded that East Side sockeye salmon stocks mixed in all East Side Districts and that West Side stocks were not present in appreciable numbers in East Side districts. Examining the 1985 East Side commercial catches, Fried and Yuen (1985) found that scale pattern analysis could accurately identify major East Side sockeye salmon stocks. Scale pattern studies were expanded in 1986 and stock compositions of East Side district catches have been estimated from 1983 to present (Bue et al. 1986; Cross and Stratton 1989, 1991; Burns 1991; Cross et al. 1992).

Objectives of this ongoing investigation of the East Side sockeye salmon runs include (1) estimation of stock composition in East Side commercial sockeye salmon harvests; (2) estimation of total run by river; and (3) comparison of run estimates by river obtained from scale pattern analyses with the standard method. For this report, the objectives were specific to the 1990 run.

METHODS

Catch and Escapement Estimation

Commercial catch statistics in this report were documented in ADF&G (1991); these statistics were computed from final operation reports prepared by fish processors. The numbers in this report may differ slightly from final ADF&G catch statistics because minor errors may be detected. Sockeye salmon escapement estimates were based on visual counts made from towers on the banks of Kvichak, Naknek, Egegik and Ugashik Rivers (ADF&G 1991).

Age Composition Estimation

European notation (Koo 1962) was used to record ages; numerals preceding the decimal refer to number of freshwater annuli, numerals following the decimal refer to number of marine annuli. Total age from time of egg deposition (brood year) is the sum of these numbers plus one. Complete methods and results of sampling 1990 Bristol Bay sockeye salmon catches and escapements have been summarized and published in a separate report (Stratton 1991).

Catch Composition Estimation

Linear discriminant function analysis (Fisher 1936) of scale patterns combined with age composition data were used to determine sockeye salmon stock origins in the 1990 East Side harvests. Sockeye salmon harvested from selected setnet beaches in Naknek-Kvichak and Egegik Districts were also sampled in 1990 and classified to river of origin.

Scale Measurements

Scale impressions were projected at 100X magnification onto a digitizing tablet using equipment similar to that described by Ryan and Christie (1976). Measurements were taken along the anterior-posterior axis to standardize each scale. This axis is approximately 20° ventral of the long axis and perpendicular to the sculptured (anterior) field (Figure 3). Distances between growth rings (circuli) were measured to the nearest 0.01 in, and number of circuli counted from (1) center of scale focus to outside edge of first freshwater annulus (first freshwater annular zone), (2) outside edge of first freshwater annulus to outside edge of second freshwater annulus (second freshwater annular zone), (3) outside edge of last freshwater annulus to end of freshwater growth (freshwater plus growth zone), if present, and (4) outside edge of last freshwater circulus to outer edge of first ocean annulus (first marine annular zone). Total distance from the outside edge of first ocean annulus to outside edge of second ocean annulus (second marine annular zone) was recorded for age-1.3 and -2.3 sockeye salmon. A total of 75 variables for age-1.3 samples, 108 for age-2.2 samples, and 109 for age-2.3 samples were computed from distance measurements and circuli counts (Table 1).

Linear Discriminant Analysis

Escapement samples from Kvichak, Naknek, Egegik, and Ugashik Rivers provided known-origin scales used to build linear discriminant functions (LDF). Branch River, a Kvichak River tributary, was not included in the Kvichak standard as (1) it is numerically small compared to the Kvichak River run; Kvichak escapement was estimated to be 6,970,020, Branch escapement was estimated to be 168,578; and (2) Branch River age composition was determined by examining otoliths rather than scales (Stratton 1991).

Commercial catch samples provided scales of unknown origin. Escapement samples collected in 1990 were used to classify 1990 catches in age-specific LDF models.

Frequency distribution plots for principal scale variables for each growth zone were examined. Differences between mean number of circuli and size of selected growth zones for males and females were compared using independent *t*-tests. Scale variable selection for each discriminant model was made using a forward stepping procedure with partial *F*-statistics as criteria for entry or removal of variables (Enslein et al. 1977). This process was continued until model accuracy ceased improving. The equality of variance-covariance matrices were tested using an *F*-statistic described by Box (1949). A nearly unbiased estimate of overall classification accuracy for each LDF was determined with a "leaving-one-out procedure" (Lachenbruch 1967).

Construction of Age-2.2 Models. A four-way linear discriminant model was constructed from scale measurements of age-2.2 sockeye salmon entering Kvichak, Naknek, Egegik, and Ugashik Rivers. Approximately 200 scale samples from each 1990 escapement weighted by run strength through time were used to build discriminant models.

Classification of Age-2.2 Sockeye Salmon. The four-way linear discriminant model was used to classify 1991 district catches of age-2.2 sockeye salmon. Proportion by stock estimates in the catches derived from the model were adjusted for misclassification error with the procedure of Cook and Lord (1978). The adjusted proportions were assumed to reflect true stock composition. Variance and 90% confidence intervals around adjusted estimates were computed using the procedure of Pella and Robertson (1979). A catch sample was reclassified with a model representing fewer stocks if the adjusted proportion was ≤ 0 for one or more stocks in the four-way model.

The number of age-2.2 sockeye salmon for stock *i* in a specific catch stratum, ($\hat{C}_{i2.2}$) was calculated as:

$$\hat{C}_{i2.2} = \hat{C} \hat{P}_{2.2} \hat{S}_{i2.2} , \quad (1)$$

where:

- \hat{C} = estimated catch of sockeye salmon in a fishery at a given time,
- $\hat{P}_{2.2}$ = estimated proportion of age-2.2 sockeye salmon in the catch, and
- $\hat{S}_{i2.2}$ = estimated proportion of age-2.2 sockeye salmon of stock *i* in the catch.

In this procedure, the variance about catch (\hat{C}) is not evaluated. Consequently, a conditional variance of the estimated age-2.2 sockeye salmon catch ($V[\hat{C}_{i2.2}]$) for each stock in a specific fishery at a given time was calculated as described by Goodman (1960). This provided an exact variance of a product conditional on catch:

$$V[\hat{C}_{i2.2}] = C^2 V[\hat{P}_{2.2} \hat{S}_{i2.2}] \quad , \quad (2)$$

$$V[\hat{P}_{2.2} \hat{S}_{i2.2}] = V[\hat{P}_{2.2}] \hat{S}_{i2.2}^2 + V[\hat{S}_{i2.2}] \hat{P}_{2.2}^2 - V[\hat{S}_{i2.2}] V[\hat{P}_{2.2}] \quad (3)$$

Contributions for each stock through time for a specific fishery were added to estimate total contribution to that fishery. The variance of the total contribution was calculated by summing the variances for each period. The contributions by stock to each fishery were added to produce the total contribution by stock to the East Side age-2.2 sockeye salmon harvest. The variance of the total contribution by stock was calculated as the sum of the variances for each fishery.

Construction of Age-1.3 Models. A four-way linear discriminant model was constructed from scale measurements of age-1.3 sockeye salmon entering Kvichak, Naknek, Egegik, and Ugashik Rivers. Models were built with age-1.3 scale samples from each 1990 escapement weighted by run strength through time.

Construction of Age-2.3 Models. A four-way linear discriminant model was built from scale measurements of age-2.3 sockeye salmon entering Kvichak, Naknek, Egegik, and Ugashik Rivers. Scale samples from each 1990 escapement weighted by run strength through time were used to build discriminant models. Frequency distribution plots of the total size of freshwater growth zones for Naknek and Egegik River stocks were similar (Figure 4). Therefore, all Naknek and Egegik River samples were pooled. A three-way linear discriminant model was built using scales from Kvichak, Ugashik, and a pooling of Naknek and Egegik.

Classification of Age-2.3 Sockeye Salmon. Linear discriminant models were used to assign unknown samples to river of origin. Procedures for the age-2.3 analysis were the same as those used for the age-2.2 analysis.

Separation of Naknek-Egegik Age-2.3 Catch

Proportions of age-2.3 sockeye salmon classified to the Naknek/Egegik aggregate were separated to their respective river based on scale pattern estimates for age-2.2 sockeye salmon and age composition of escapements:

$$\hat{S}_{i2.3} = \hat{S}_{p2.3} \frac{\hat{T}_{i2.3}}{\sum_{i=1}^n \left(\hat{S}_{i2.2} \frac{\hat{T}_{i2.3}}{\hat{T}_{i2.2}} \right)} , \quad (4)$$

$$\hat{S}_{i2.2} = \frac{\hat{C}_{i2.2}}{\hat{C}_{2.2}} , \quad (5)$$

$$\hat{T}_{i2.2} = \frac{\hat{E}_{i2.2}}{\hat{E}_i} , \quad (6)$$

where:

- $\hat{S}_{i2.3}$ = estimated proportion of age-2.3 sockeye salmon of stock i (Naknek or Egegik) in the catch,
- $\hat{S}_{p2.3}$ = estimated proportion of age-2.3 sockeye salmon of Naknek-Egegik pooled stocks in the catch,
- $\hat{T}_{i2.3}$ = estimated proportion of age-2.3 sockeye salmon in stock i escapement,
- $\hat{T}_{i2.2}$ = estimated proportion of age-2.2 sockeye salmon in stock i escapement,
- $\hat{C}_{i2.2}$ = estimated number of age-2.2 sockeye salmon of stock i in the catch,
- $\hat{C}_{2.2}$ = estimated numbers of age-2.2 sockeye salmon in the catch,
- $\hat{E}_{i2.2}$ = estimated number of age-2.2 sockeye salmon in stock i escapement,
- \hat{E}_i = number of sockeye salmon in stock i escapement, and
- n = number of stocks.

Two assumptions were made: (1) age composition of Naknek and Egegik River escapements represented the catch age composition; and (2) exploitation of age-2.3 sockeye salmon within Naknek and Egegik Rivers was equal to exploitation of age-2.2 sockeye salmon within those rivers.

Other Age Group Stock Composition Estimation

Estimates of stock composition for sockeye salmon of other ages harvested in East Side districts were based on scale pattern estimates for age-2.2 and -2.3 sockeye salmon, and the ratio of age-2.2 and -2.3 sockeye salmon to sockeye salmon of other age groups within respective escapements:

$$\hat{S}_{ij} = \frac{\hat{S}_{i(2.2,2.3)} \frac{\hat{T}_{ij}}{\hat{T}_{i(2.2,2.3)}}}{\sum_{i=1}^n \left(\hat{S}_{i(2.2,2.3)} \frac{\hat{T}_{ij}}{\hat{T}_{i(2.2,2.3)}} \right)} , \quad (7)$$

$$\hat{S}_{i(2.2,2.3)} = \frac{\hat{C}_{i2.2} + \hat{C}_{i2.3}}{\hat{C}_{2.2} + \hat{C}_{2.3}} , \quad (8)$$

$$\hat{T}_{i(2.2,2.3)} = \frac{\hat{E}_{i2.2} + \hat{E}_{i2.3}}{\hat{E}_i} , \quad (9)$$

where:

- \hat{T}_{ij} = estimated proportion of age j sockeye salmon in stock i escapement;
- $\hat{T}_{i(2.2,2.3)}$ = estimated proportion of combined age-2.2 and age-2.3 sockeye salmon of stock i in the escapement;
- $\hat{C}_{i2.3}$ = estimated number of age-2.3 sockeye salmon of stock i in the catch;
- $\hat{C}_{2.3}$ = estimated number of age-2.3 sockeye salmon in the catch; and
- $\hat{E}_{i2.3}$ = estimated number of age-2.3 sockeye salmon in stock i escapement

Run Size Estimation

Sockeye salmon run size to each river was estimated by adding estimates of catch by stock to escapement estimates. For each river, we computed the percentage (1) harvested within the natal district, (2) harvested outside the natal district, and (3) that escaped. Finally, run size estimates from scale pattern analysis were compared with estimates from the standard method.

RESULTS

Catch and Escapement

Commercial fishermen harvested an estimated 29,357,846 sockeye salmon in East Side districts in 1990 (Table 2). This was much greater than the 1980-89 average catch of 18.3 million. The 17,126,625

sockeye salmon caught in Naknek-Kvichak District accounted for 58.3% of the East Side harvest; commercial harvests in Egegik were 10,086,953 or 34.4% of the East Side harvest and in Ugashik were 2,144,268 or 7.3%.

Sockeye salmon escapements in 1990 were estimated to be 6,970,020 in Kvichak River, 2,092,578 in Naknek River, 2,191,362 in Egegik River, and 730,038 in Ugashik River (Table 3).

Age Composition

Four age groups made up 98.9% of the East Side sockeye salmon catch: age-1.2 was 12.0%, age-1.3 was 19.1%, age-2.2 was 39.6%, and age-2.3 was 28.2% (Table 4). Naknek-Kvichak District catch was 45.0% age-2.2, 22.6% age-1.3, and 20.4% age-2.3. Egegik District catch was 41.6% age-2.3 and 32.2% age-2.2. Ugashik District catch was 31.3% age-2.2, 27.7% age-2.3, and 24.2% age-1.3.

Age composition of sockeye salmon escapements varied among runs (Table 5). Kvichak River escapement was 87.6% age-2.2 sockeye salmon. Naknek River escapement was 30.6% age-1.3, 28.1% age-1.2, and 27.6% age-2.2. Egegik River escapement was 42% age-2.2, 25% age-1.2, and 25% age-2.3. Ugashik River escapement was 38% age-2.2, 24% age-1.3, and 22% age-1.2.

Classification Models

Age 2.2

Scale characteristics which differed the most among age-2.2 sockeye salmon stocks were variables 63, 8, and 57 (Table 6). In general, freshwater growth of sockeye salmon was greatest in Egegik River, followed by Naknek, Ugashik, and Kvichak Rivers. Frequency distribution plots of the total number of circuli in the freshwater growth zone showed Kvichak River samples to be most distinctive and Naknek and Egegik River samples to be the most similar (Figure 5).

T-statistics were computed to test for differences in mean circuli number and major growth zone size between males and females within each stock (Table 7). Significant differences ($P \leq 0.05$) between sexes were found for the size of the first ocean growth zone within Kvichak ($t = 4.36$), Egegik ($t = 2.37$), and Ugashik ($t = 3.87$) River samples and for the size of the first freshwater growth zone in Egegik River samples ($t = 3.78$). Because no growth zones were consistently different between sexes for all stocks, samples of males and females were combined to build the models.

Estimated overall classification accuracy for the four-way age-2.2 model was 75.0% (Table 8). Individual stock classification accuracy was greatest for Kvichak (87.3%), similar for Egegik (76.5%) and Ugashik (75.4%), and least for Naknek (60.9%) River. Samples from Naknek River misclassified mostly to Egegik

and Ugashik Rivers. The range of overall classification accuracies were 80.4% to 87.8% for three-way models and 89.8% to 98.0% for two-way models.

Age 1.3

Scale characteristics which differed the most among stocks of age-1.3 sockeye salmon were variables 14, 77, and 24 (Table 9). Estimated overall classification accuracy for the four-way age-1.3 model was 69.2% (Table 10). Individual stock classification accuracy was greatest for Egegik (85.9%), followed by Kvichak (75.0%) Naknek (61.0%), and Ugashik (55.0%) Rivers. Due to small sample sizes, poor model accuracy, and budget limitations, this model was not used to classify age-1.3 catches to river of origin.

Age 2.3

Scale variables were similar between Naknek and Egegik samples, and the four way model could not accurately differentiate between these stocks (Table 11; Figure 4). Kvichak and Ugashik stocks were distinct (Figure 6). Therefore, we pooled Naknek and Egegik samples and compared them to Kvichak and Ugashik River samples in a three-way model. Scale measurements that provided the greatest discrimination among age-2.3 sockeye salmon in the three-way model were variables 65, 27, and 67 (Table 11). Freshwater growth was greatest for the Naknek/Egegik component, and least for Kvichak River (Table 11; Figure 6).

T-statistics were computed to test for differences in mean circuli number and major growth zone size between males and females within each stock (Table 12). Significant differences ($P < 0.05$) between sexes were found for the size of the first ocean growth zone for Naknek ($t = 3.05$), Egegik ($t = 2.13$), and Ugashik ($t = 5.11$) Rivers, and in the size of the second ocean growth zone for Kvichak ($t = 2.72$) and Egegik ($t = 2.29$) Rivers. Since no growth zones were consistently different between sexes for all stocks, samples of males and females were combined to build the models.

Estimated overall classification accuracy for the three-way, age-2.3 model was 83.3% (Table 13). Individual stock classification accuracy was fairly high and similar for all groups: Kvichak was 84.3%; Naknek/Egegik was 83.5%; and Ugashik was 82.2%. Overall classification accuracy for the two-way model was 93.3%.

Estimates of Catch Composition

Age 2.2

Most age-2.2 sockeye salmon harvested in each district originated from rivers within the district (Table 14). Of the estimated 7,702,820 age-2.2 sockeye salmon caught in Naknek-Kvichak District, 96.6%

originated within the district and 3.4% from outside the district (Figure 7). The percentage of Kvichak River sockeye salmon in Naknek/Kvichak District catches remained high throughout the season (NSC = non-statistical comparison). Of the estimated 3,248,740 age-2.2 sockeye salmon caught in Egegik District, 56.6% originated from Egegik River and 43.4% were produced outside the district (Figure 8). The percentage of Egegik River age-2.2 sockeye salmon harvested in Egegik District was low early in the season, while the percentage of Kvichak sockeye salmon generally declined during the season (NSC). The estimated catch of age-2.2 sockeye salmon in Ugashik District was 673,465; 84.0% originated in Ugashik River and 16.0% from outside the district (Figure 9). The contribution of Ugashik River age-2.2 sockeye salmon to Ugashik District catches was low prior to 26 June, and high after that date (NSC).

The 90% confidence intervals around stock composition point estimates of age-2.2 sockeye salmon are presented in Table 14. Coefficients of variation for stock estimates were low for the most abundant stocks: 2.4 for Kvichak River, 5.4 for Egegik River, 10.7 for Ugashik River, and 15.8 for Naknek River (Table 15).

Age 2.3

Most age-2.3 sockeye salmon harvested in each district originated from rivers within the district (Table 16). Of the estimated 3,491,358 age-2.3 sockeye salmon caught in Naknek-Kvichak District, 88.4% originated within the district and 11.6% from outside the district (Figure 10). The percentage of Naknek River sockeye salmon increased while the percentage of Kvichak River sockeye salmon decreased through time in Naknek-Kvichak District age-2.3 catches (NSC). Of the estimated 4,192,760 age-2.3 sockeye salmon caught in Egegik District, 90.9% originated from Egegik River and 9.1% were produced outside the district (Figure 11). The percentage of Egegik age-2.3 sockeye salmon increased during the season (NSC). The estimated catch of age-2.3 sockeye salmon in Ugashik District was 590,690, 48.2% originated in Ugashik River and 51.8% from stocks outside the district (Figure 12). Egegik River sockeye salmon contributed 43.4% of the Ugashik District age-2.3 harvest.

The 90% confidence intervals around stock composition point estimates of age-2.3 sockeye salmon are presented in Table 16. Coefficients of variation for stock proportion estimates were lowest for the most abundant stocks: 2.4 for Naknek/ Egegik, 5.2 for Kvichak River, and 15.1 for Ugashik River (Table 17).

All Ages

The Naknek-Kvichak District harvest was comprised of an estimated 8,884,729 sockeye salmon from Kvichak River, 6,914,552 from Naknek River, 524,187 from Egegik River, and 803,157 from Ugashik River (Table 18). Estimated stock contribution to the Naknek-Kvichak District total catch were 51.8% for Kvichak, 40.4% for Naknek, 3.1% for Egegik, and 4.7% for Ugashik Rivers (Figure 13). Comparisons of stock composition estimates from Naknek-Kvichak District and Naknek Section only openings can be found in Appendix A.1. On north Naknek beach, stock composition of setnet harvests between Libbyville and Pederson Point were similar (NSC) to harvests between Pederson Point and the inside district marker

(Table 19). However, stock composition of harvests differed greatly (NSC) between north Naknek beach study areas and the south Naknek beach study area. Kvichak River sockeye salmon were the largest component of south Naknek beach catches, while Naknek River sockeye salmon were the largest component of north Naknek beach catches. However, because samples were taken later in the season from the south Naknek beach, it is not known whether stock composition estimates differ due to sample location or time.

Of the sockeye salmon caught in Egegik District an estimated 7,870,917 were from Egegik River, 1,673,382 from Kvichak River, 302,843 from Naknek River, and 239,811 from Ugashik River (Table 20). Estimated stock contributions to the Egegik District total catch were 78.0% from Egegik, 16.6% from Kvichak, 3.0% from Naknek, and 2.4% from Ugashik Rivers (Figure 14). All setnet catches sampled had higher percentages of Egegik River sockeye salmon than the total Egegik District catch, which was primarily harvested by drift nets (Table 21). Setnet catches south of Bishop Creek (Bishop Creek to King Salmon River) had higher percentages of Egegik River sockeye salmon than those north of Bishop Creek (Big Creek to Bishop Creek). Stock composition estimates for setnet catch samples in Egegik District in 1990 were similar to those made in 1989 (Cross et al 1992).

The Ugashik District catch was comprised of an estimated 1,581,788 sockeye salmon from Ugashik River, 444,748 from Egegik River, 110,600 from Kvichak River, and 7,132 from Naknek River (Table 22). Estimated stock contribution to the total Ugashik District sockeye salmon catch were 73.8% from Ugashik River, 20.7% from Egegik River, 5.2% from Kvichak River, and 0.3% from Naknek River (Figure 15).

Harvest Distribution

Of the estimated 10,668,711 Kvichak River sockeye salmon harvested in 1990, 83.3% were taken in Naknek-Kvichak, 15.7% in Egegik, and 1.0% in Ugashik Districts (Table 23). Of the estimated 7,224,527 Naknek River sockeye salmon harvested in 1990, 95.7% were taken in Naknek-Kvichak District, 4.2% in Egegik District, and 0.1% in Ugashik District. Of the estimated 8,838,852 Egegik River sockeye salmon harvested in 1990, 89.1% were taken in Egegik District, 5.9% in Naknek-Kvichak District, and 5.0% in Ugashik District. Of the estimated 2,624,756 Ugashik River sockeye salmon harvested in 1990, 60.3% were taken in Ugashik District, 30.6% in Naknek-Kvichak District, and 9.1% in Egegik District.

An estimated 2,093,957 sockeye salmon destined for Kvichak and Naknek Rivers were harvested outside their natal district, whereas Naknek-Kvichak District fishermen caught 1,327,344 sockeye salmon bound for other districts. Therefore, Naknek-Kvichak District fishermen had a potential net loss of 766,613 sockeye salmon. The number of Egegik River sockeye salmon harvested in other districts was 968,935, whereas fishermen in Egegik District caught 2,216,036 sockeye salmon bound for other districts. Therefore, Egegik District fishermen realized a net gain of 1,247,101 sockeye salmon. An estimated 1,042,968 Ugashik River sockeye salmon were harvested outside Ugashik District, whereas 562,480 sockeye salmon from other rivers were caught in Ugashik District. Therefore, Ugashik District fishermen had a net loss of 480,488 sockeye salmon.

Run By River System

Run Distribution

The 1990 Kvichak River run was estimated to be 17,638,731 sockeye salmon: 39.5% escaped, 50.4% were harvested in Naknek-Kvichak District, and 10.1% were harvested in other districts (Tables 24, 25; Figure 16). The 1990 Naknek River run was estimated to be 9,317,105 sockeye salmon: 22.5% escaped, 74.2% were harvested in Naknek-Kvichak District, and 3.3% were harvested in other districts (Figure 17). The Egegik River run was estimated to be 11,031,214 sockeye salmon: 19.9% escaped, 71.4% were harvested in Egegik District, and 8.8% were harvested in other districts (Figure 18). The Ugashik River run was estimated to be 3,354,794: 21.8% escaped, 47.2% were harvested in Ugashik District, and 31.1% were harvested in other districts (Figure 19).

Exploitation Rates

The Ugashik River run had the highest estimated rate of exploitation outside the natal district (31.1%), followed by 10.1% for Kvichak River, 8.8% for Egegik River, and 3.3 % for Naknek Rivers. Total exploitation rates -- i.e., harvests inside and outside the natal district -- were 60.5% for Kvichak River, 77.5% for Naknek River, 80.1% for Egegik River, and 78.2% for Ugashik River (Tables 24, 25; Figures 16-19).

Comparison Of Run Estimates

Run estimates based on the standard method cannot be directly compared to those based on scale pattern analysis because the Branch River stock was not included in linear discriminant models. Therefore, we adjusted standard run estimates so that the Naknek-Kvichak District catch was only divided between Kvichak and Naknek Rivers. Egegik River had the greatest difference in estimated run size between the two methods (Table 26). The standard method estimate for the Egegik River run was 1,247,101 sockeye salmon greater than that obtained from scale pattern analysis. Estimates for Naknek River differed by 703,701, with the standard method estimate being lower. Estimates for Ugashik River differed by 480,488, with the standard method estimate again being lower. The standard method estimate of run size for Kvichak River was similar to the scale pattern analysis estimate. In general, harvests of stocks outside their natal districts in 1990 resulted in the standard method over-estimating runs to Egegik River and under-estimating runs to Kvichak, Naknek, and Ugashik Rivers.

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Table 1. Scale variables screened for linear discriminant function analysis of age-2.2, -1.3, and -2.3 sockeye salmon for the East Side of Bristol Bay, 1990.

Variable Number	Variable Name	Zone
<u>First Freshwater Annular Zone</u>		
1	NC1FW	Number of circuli first freshwater
2	S1FW	Size (width) of first freshwater
3 (16)	C0-C2	Distance, scale focus (C0) to circulus 2 (C2)
4 (17)	C0-C4	Distance, scale focus to circulus 4
5 (18)	C0-C6	Distance, scale focus to circulus 6
6 (19)	C0-C8	Distance, scale focus to circulus 8
7 (20)	C2-C4	Distance, circulus 2 to circulus 4
8 (21)	C2-C6	Distance, circulus 2 to circulus 6
9 (22)	C2-C8	Distance, circulus 2 to circulus 8
10 (23)	C4-C6	Distance, circulus 4 to circulus 6
11 (24)	C4-C8	Distance, circulus 4 to circulus 8
12 (25)	C(NC-4)-E1FW	Distance, circulus (number circuli first freshwater minus 2) to end first freshwater
13 (26)	C(NC-2)-E1FW	Distance, circulus (number circuli first freshwater minus 4) to end first freshwater
14	C2-E1FW	Distance, circulus 2 to end first freshwater
15	C4-E1FW	Distance, circulus 4 to end first freshwater
16 thru 26	C0-C2/S1FW ... C(NC-2)-E1FW/S1FW	Relative widths, (variables 3-13)/S1FW
27	S1FW/NC1FW	Average interval between circuli in first freshwater
28	NC 1ST 3/4	Number of circuli in first 3/4 of first freshwater
29	MAX DIST	Maximum distance between 2 consecutive circuli in first freshwater
30	MAX DIST/S1FW	Relative width, (variable 29)/S1FW
<u>Second Freshwater Annular Zone</u>		
31	NC2FW	Number of circuli second freshwater
32	S2FW	Size (width) of second freshwater
33 (46)	E1FW-C2	Distance, end of first freshwater to circulus 2 (C2) in second freshwater
34 (47)	E1FW-C4	Distance, end of first freshwater to circulus 4
35 (48)	E1FW-C6	Distance, end of first freshwater to circulus 6
36 (49)	E1FW-C8	Distance, end of first freshwater to circulus 8
37 (50)	C2-C4	Distance, circulus 2 to circulus 4
38 (51)	C2-C6	Distance, circulus 2 to circulus 6
39 (52)	C2-C8	Distance, circulus 2 to circulus 8
40 (53)	C4-C6	Distance, circulus 4 to circulus 6
41 (54)	C4-C8	Distance, circulus 4 to circulus 8
42 (55)	C(NC-4)-E2FW	Distance, circulus (number circuli second freshwater minus 4) to end second freshwater
43 (56)	C(NC-2)-E2FW	Distance, circulus (number circuli second freshwater minus 2) to end second freshwater
44	C2-E2FW	Distance, circulus 2 to end second freshwater
45	C4-E2FW	Distance, circulus 4 to end second freshwater
46 thru 56	E1FW-C2/S2FW ... C(NC-2)-E2FW/S2FW	Relative widths, (variables 33-43)/S2FW
57	S2FW/NC2FW	Average interval between circuli in second freshwater
58	NC 1ST 3/4	Number of circuli in first 3/4 of second freshwater
59	MAX DIST	Maximum distance between 2 consecutive circuli in second freshwater
60	MAX DIST/S2FW	Relative width, (variable 59)/S2FW

-Continued-

Table 1. (p 2 of 2).

Variable Number	Variable Name	Zone
<u>Plus Growth Zone</u>		
61	NCPG	Number of circuli in plus growth
62	SPGZ	Size (width) plus growth zone
<u>Freshwater and Plus Growth Zones</u>		
63	NC1FW + NC2FW	Total number of circuli first and second freshwater
64	S1FW + S2FW	Total size (width) of first and second freshwater
65	NC1FW+NC2FW+NCPG	Total number of circuli first and second freshwater and plus growth
66	S1FW+S2FW+SPGZ	Total size (width) first and second freshwater and plus growth
67	S1FW/S1FW+S2FW+SPGZ	Relative width, (variable 2)/S1FW+S2FW+SPGZ
68	SPGZ/S1FW+S2FW+SPGZ	Relative width, (variable 62)/S1FW+S2FW+SPGZ
69	S2FW/S1FW+S2FW+SPGZ	Relative width, (variable 32)/S1FW+S2FW+SPGZ
<u>First Marine Annular Zone</u>		
70	NC10Z	Number of circuli in first ocean zone
71	S10Z	Size (width) first ocean zone
72 (90)	EFW-C3	Distance, end of freshwater growth to circulus 3
73 (91)	EFW-C6	Distance, end of freshwater growth to circulus 6
74 (92)	EFW-C9	Distance, end of freshwater growth to circulus 9
75 (93)	EFW-C12	Distance, end of freshwater growth to circulus 12
76 (94)	EFW-C15	Distance, end of freshwater growth to circulus 15
77 (95)	C3-C6	Distance, circulus 3 to circulus 6
78 (96)	C3-C9	Distance, circulus 3 to circulus 9
79 (97)	C3-C12	Distance, circulus 3 to circulus 12
80 (98)	C3-C15	Distance, circulus 3 to circulus 15
81 (99)	C6-C9	Distance, circulus 6 to circulus 9
82 (100)	C6-C12	Distance, circulus 6 to circulus 12
83 (101)	C6-C15	Distance, circulus 6 to circulus 15
84 (102)	C9-C15	Distance, circulus 9 to circulus 15
85 (103)	C(NC-6)-E10Z	Distance, circulus (number circuli first ocean minus 6) to end first ocean
86 (104)	C(NC-3)-E130Z	Distance, circulus (number circuli first ocean minus 3) to end first ocean
87	C3-E10Z	Distance, circulus 3 to end of first ocean
88	C9-E10Z	Distance, circulus 9 to end of first ocean
89	C15-E10Z	Distance, circulus 15 to end of first ocean
90 thru	EFW-C3/S10Z ...	Relative widths, (variables 72-86)/S10Z
104	C(NC-3)-E130Z/S10Z	
105	S10Z/NC10Z	Average interval between circuli in first ocean
106	NC 1ST 1/2	Number of circuli in first 1/2 of first ocean
107	MAX DIST	Maximum distance between 2 consecutive circuli in first ocean
108	MAX DIST/S10Z	Relative width, (variable 107)/S10Z
<u>Second Marine Annular Zone</u>		
109	S20Z	Size (width) of second ocean zone

Table 2. Sockeye salmon commercial catch by district and date for the East Side of Bristol Bay, 1990.

Date	Catch (Nos. of Fish) ^a			
	Naknek/Kvichak	Egegik	Ugashik	East Side
6/04-6/16	4,176	9,781	1,186	15,143
6/18	15,789	175 ^b	7,067	23,031
6/19	19,534	324 ^b	11,933	31,791
6/20	25,096	904 ^b	14,645	40,645
6/21	53,679	69,087	3,272	126,038
6/22	67,100	245 ^b	9,955	77,300
6/23-6/27		15,102 ^b	37 ^b	15,401
6/28	72,536	37,589		110,125
6/29	742,371	314,741	283 ^b	1,057,395
6/30	960,844	7,872 ^b		968,716
7/01	29,920	5,076 ^b		34,996
7/02	838,159	1,204,893	1,177 ^b	2,044,229
7/03	2,107,281	1,114,046	951 ^b	3,222,278
7/04	885,168	81,104	217,837	1,184,109
7/05	2,042,522	793,064		2,835,586
7/06	851,431	1,205,186	1,442 ^b	2,058,059
7/07	1,091,576	424,006	1,137 ^b	1,516,719
7/08	758,625	979,918	302,161	2,040,704
7/09	1,070,849		437,275	1,508,124
7/10	444,118	1,174,215	199 ^b	1,618,532
7/11	1,229,946		356,354	1,586,300
7/12-7/13	1,343,793	1,032,813	1,517	2,378,123
7/14	543,572	532,527	70,256	1,146,355
7/15	648,605	94,760	192,260	935,625
7/16	333,826	294,086	1,513 ^b	629,425
7/17	321,410	191,548	196,703	709,661
7/18	178,743	148,266	93,240	420,249
7/19	148,908	132,333	74,670	355,911
7/20	122,647	56,560	32,304	211,511
7/21	41,335	42,016	28,744	112,095
7/22		28,293	18,670	46,963
7/23-7/27	109,041	76,905	42,820	228,766
7/30-8/03	18,778	14,166	18,756	51,700
8/06-8/10	4,558	4,025	4,215	12,798
8/13-9/07	687	1,065	1,689	3,441
Total	17,126,625	10,086,953	2,144,268	29,357,846
Percent	58.3	34.4	7.3	100.0

^a Blanks indicate a district was closed.

^b ADF&G test fish catch

Table 3. Sockeye salmon escapement by river and date for the East Side of Bristol Bay, 1990.

Date	Kvichak River		Naknek River		Egegik River		Ugashik River	
	Daily	Cumulative	Daily	Cumulative	Daily	Cumulative	Daily	Cumulative
06/21					60	60		
06/22					24	84		
06/23			6,126	7,284	0	84		
06/24			2,190	9,474	642	726		
06/25	942	942	3,762	13,236	1,194	1,920		
06/26	1,110	2,052	69,396	82,632	1,218	3,138		
06/27	1,350	3,402	17,496	100,128	720	3,858		
06/28	2,232	5,634	27,606	127,734	5,142	9,000		
06/29	2,694	8,328	146,736	274,470	14,832	23,832		
06/30	31,104	39,432	146,694	421,164	27,126	50,958		
07/01	6,228	45,660	137,100	558,264	41,208	92,166		
07/02	173,064	218,724	285,234	843,498	261,582	353,748		
07/03	606,654	825,378	75,528	919,026	334,050	687,798	474	474
07/04	586,980	1,412,358	158,478	1,077,504	349,668	1,037,466	774	1,248
07/05	461,508	1,873,866	108,486	1,185,990	138,978	1,176,444	1,404	2,652
07/06	525,504	2,399,370	174,054	1,360,044	137,634	1,314,078	2,484	5,136
07/07	502,110	2,901,480	113,286	1,473,330	73,416	1,387,494	816	5,952
07/08	607,410	3,508,890	45,426	1,518,756	51,636	1,439,130	11,316	17,268
07/09	552,180	4,061,070	34,362	1,553,118	28,644	1,467,774	21,192	38,460
07/10	630,690	4,691,760	58,086	1,611,204	68,520	1,536,294	28,512	66,972
07/11	389,130	5,080,890	91,866	1,703,070	58,986	1,595,280	52,932	119,904
07/12	307,350	5,388,240	79,524	1,782,594	142,782	1,738,062	88,320	208,224
07/13	414,600	5,802,840	54,324	1,836,918	119,226	1,857,288	119,148	327,372
07/14	405,150	6,207,990	34,152	1,871,070	76,122	1,933,410	98,910	426,282
07/15	210,108	6,418,098	26,304	1,897,374	52,758	1,986,168	55,200	481,482
07/16	91,980	6,510,078	38,646	1,936,020	118,032	2,104,200	51,414	532,896
07/17	93,360	6,603,438	36,678	1,972,698	23,718	2,127,918	32,592	565,488
07/18	70,434	6,673,872	22,470	1,995,168	13,254	2,141,172	57,162	622,650
07/19	58,692	6,732,564	17,280	2,012,448	13,890	2,155,062	29,988	652,638
07/20	48,510	6,781,074	20,934	2,033,382	15,612	2,170,674	15,666	668,304
07/21	46,056	6,827,130	17,010	2,050,392	5,874	2,176,548	13,992	682,296
07/22	48,876	6,876,006	14,064	2,064,456	5,034	2,181,582	7,428	689,724
07/23	38,748	6,914,754	18,636	2,083,092	4,056	2,185,638	2,604	692,328
07/24	26,706	6,941,460	9,486	2,092,578	3,852	2,189,490	4,470	696,798
07/25	28,560	6,970,020			1,872	2,191,362	3,018	699,816
07/26							3,438	703,254
07/27							7,104	710,358
07/28							9,870	720,228
07/29							9,810	730,038
Total	6,970,020		2,092,578		2,191,362 ^a		730,038 ^b	

^a An additional 220 sockeye salmon were counted in the King Salmon River drainage, bringing the Egegik District sockeye salmon escapement total to 2,191,582.

^b An additional 8,100 and 11,340 sockeye salmon were counted in Dog Salmon and King Salmon River drainages, bringing the Ugashik District sockeye salmon escapement total to 749,478.

Table 4. Sockeye salmon age composition by brood year in the commercial catch for the East Side of Bristol Bay, 1990.

			1987		1986		1985		1984			1983		
District	Sample Size		0.2	0.3	1.2	2.1	1.3	2.2	1.4	2.3	3.2	2.4	3.3	Total
Naknek/ Kvichak	7,527	Numbers	18,651	22,029	1,985,272	4,103	3,867,918	7,702,820	19,827	3,491,358	12,627		2,020	17,126,625
		Percent	0.1	0.1	11.6	0.0 ^a	22.6	45.0	0.1	20.4	0.1		0.0 ^a	100.0
		SE	6,240	8,821	60,524	3,707	83,834	98,181	6,240	79,848	6,240		2,988	
Egegik	5,258	Numbers	167	13,054	1,203,574	167	1,215,720	3,248,740	9,369	4,192,760	166,725	21,097	15,580	10,086,953
		Percent	0.0 ^a	0.1	11.9	0.0 ^a	12.1	32.2	0.1	41.6	1.6	0.2	0.2	100.0
		SE	164	6,215	46,010	164	46,167	66,133	4,397	67,629	16,910	6,215	4,397	
Ugashik	2,650	Numbers	2,955	25,503	318,815		516,656	673,465	12,557	590,690	2,907	720		2,144,268
		Percent	0.1	1.2	14.8		24.2	31.3	0.6	27.7	0.1	0.0 ^a		100.0
		SE	1,861	7,218	14,451		18,105	18,878	2,278	18,699	1,861	1,371		
Total	15,435	Numbers	21,773	60,586	3,507,661	4,270	5,600,294	11,625,025	41,753	8,274,808	182,259	21,817	17,600	29,357,846
		Percent	0.1	0.2	12.0	0.0 ^a	19.1	39.6	0.1	28.2	0.6	0.1	0.0 ^a	100.0

^a Represented < 0.1%

Table 5. Sockeye salmon age composition by brood year in the escapement for the East Side of Bristol Bay, 1990.

River	Sample Size		1987		1986		1985				1984			1983		Total
			0.2	1.1	0.3	1.2	2.1	0.4	1.3	2.2	1.4	2.3	3.2	2.4	3.3	
Kvichak	2,912	Numbers	11,107	3,530	8,060	211,062			234,020	6,101,908		397,935		2,398		6,970,020
		Percent	0.2	0.0 ^a	0.1	3.0			3.4	87.6		5.7		0.0 ^a		100.0
Naknek	3,523	Numbers	836		1,540	587,225	2,065	587	639,524	577,631	1,706	281,464				2,092,578
		Percent	0.0 ^a		0.1	28.1	0.1	0.0 ^a	30.6	27.6	0.1	13.4				100.0
Egegik	3,584	Numbers	1,890		349	553,754	10,039		114,787	918,871	164	548,009	42,159	991	349	2,191,362
		Percent	0.1		0.0 ^a	25.3	0.5		5.2	42.0	0.0 ^a	25.0	1.9	0.0 ^a	0.0 ^a	100.0
Ugashik	2,335	Numbers	3,527	492	19,161	161,531	743		174,878	276,080		93,626				730,038
		Percent	0.5	0.1	2.6	22.1	0.1		23.9	37.8		12.9				100.0

^a Represented < 0.1%

Table 6. Mean and standard error of age-2.2 scale variables used to construct linear discriminant functions for the East Side of Bristol Bay, 1990.

Variable Number	Variable Name	Kvichak		Naknek		Egegik		Ugashik	
		Mean ^a	SE	Mean ^a	SE	Mean ^a	SE	Mean ^a	SE
<u>First Freshwater Annular Zone</u>									
8	C2-C6	46.01	0.373	46.57	0.450	47.79	0.415	40.00	0.347
10	C4-C6	20.87	0.240	20.96	0.248	21.76	0.236	18.19	0.195
14	C2-E1FW	58.12	0.812	71.24	1.561	90.61	1.956	62.40	1.155
15	C4-E1FW	33.00	0.772	46.02	1.410	64.58	1.840	40.59	1.074
18	C0-C6/S1FW	0.89	0.005	0.81	0.008	0.72	0.008	0.81	0.007
23	C4-C6/S1FW	0.19	0.002	0.18	0.002	0.16	0.002	0.17	0.002
27	S1FW/NC1FW	14.26	0.097	13.44	0.094	13.08	0.069	12.41	0.081
29	MAX DIST.	14.61	0.115	14.62	0.147	15.03	0.130	13.18	0.133
<u>Second Freshwater Annular Zone</u>									
32	S2FW	94.97	1.074	120.11	1.322	133.43	1.186	123.13	1.187
35	E1FW-C6	65.57	0.431	68.52	0.448	69.58	0.480	73.43	0.517
38	C2-C6	44.64	0.375	46.99	0.353	48.35	0.383	51.27	0.414
42	C(NC-4)-E2FW	33.91	0.323	34.99	0.329	38.99	0.352	34.84	0.344
44	C2-E2FW	74.03	1.079	98.58	1.291	112.20	1.189	100.97	1.211
51	C2-C6/S2FW	0.48	0.004	0.40	0.005	0.37	0.004	0.42	0.004
55	VAR 42/S2FW	0.37	0.005	0.30	0.005	0.30	0.004	0.29	0.004
57	S2FW/NC2FW	9.96	0.059	10.45	0.055	11.09	0.058	10.90	0.061
<u>Freshwater and Plus Growth Zones</u>									
63	NC1+NC2	17.14	0.106	20.47	0.144	22.86	0.149	20.26	0.139
65	NC1FW+NC2FW+NCPG	18.43	0.105	21.86	0.142	23.85	0.146	21.38	0.142
66	S1FW+S2FW+SPGZ	214.03	1.262	252.84	1.696	283.19	1.996	243.17	1.575
<u>First Marine Annular Zone</u>									
71	S10Z	434.01	2.737	407.70	2.790	408.01	2.580	416.42	2.500
72	EFW-C3	52.32	0.661	50.55	0.707	56.20	0.671	54.44	0.630
73	EFW-C6	123.06	0.937	121.54	0.988	129.13	0.860	124.63	0.826
80	C3-C15	259.66	1.357	255.92	1.265	253.84	1.306	255.87	1.255
104	(C(NC-3)-E10Z)/S10Z	0.09	0.001	0.10	0.001	0.10	0.001	0.10	0.001

^a Scale images projected at 100x magnification and measured at 0.01 in; therefore, variable means are in 0.0001 in.

Table 7. Mean, variance, and t-statistic comparing males and females for selected scale variables of age-2.2 sockeye salmon sampled from Kvichak, Naknek, Egegik, and Ugashik Rivers, 1990.

River	Sex		S1FW	S2FW	SPGZ	S1FW+S2FW+ SPGZ	S10Z
Kvichak River	Male	Sample Size	87	87	76	87	87
		Mean	106.36	94.90	13.97	213.46	447.02
		Variance	145.65	172.14	41.89	287.81	1,503.77
	Female	Sample Size	113	113	92	113	113
		Mean	107.16	95.02	13.70	214.46	423.98
		Variance	151.17	277.77	48.04	344.36	1,275.07
	Combined	Sample Size	200	200	168	200	200
		Mean	107.45	94.97	13.82	214.03	434.01
		Variance	145.12	230.73	45.01	318.44	1,498.63
	T-Statistic		-0.46	-0.06	0.27	-0.39	4.36 ^a
	Male	Sample Size	121	121	104	121	121
		Mean	119.21	119.74	15.37	252.17	411.88
		Variance	515.37	347.66	72.23	561.52	1,399.61
Naknek River	Female	Sample Size	79	79	73	79	79
		Mean	119.67	121.10	15.48	253.43	401.47
		Variance	551.78	356.66	61.64	601.86	1,751.47
	Combined	Sample Size	200	200	177	200	200
		Mean	119.09	120.11	15.41	252.84	407.70
		Variance	527.08	349.65	67.49	575.21	1,557.34
	T-Statistic		-0.46	-0.14	-0.09	-0.36	1.86
	Male	Sample Size	82	82	69	82	82
		Mean	138.89	133.11	11.52	281.70	415.27
		Variance	885.83	340.25	26.31	847.89	1,383.19
	Female	Sample Size	118	118	95	118	118
		Mean	141.35	133.64	11.46	284.22	402.96
		Variance	798.90	242.66	16.93	764.99	1,244.13
	Combined	Sample Size	200	200	164	200	200
		Mean	140.34	133.43	11.49	283.19	408.01
		Variance	831.73	281.23	20.74	796.44	1,331.32
	T-Statistic		3.78 ^a	-0.22	0.08	-0.62	2.37 ^a
Egegik River	Male	Sample Size	82	82	69	82	82
		Mean	138.89	133.11	11.52	281.70	415.27
		Variance	885.83	340.25	26.31	847.89	1,383.19
	Female	Sample Size	118	118	95	118	118
		Mean	141.35	133.64	11.46	284.22	402.96
		Variance	798.90	242.66	16.93	764.99	1,244.13
	Combined	Sample Size	200	200	164	200	200
		Mean	140.34	133.43	11.49	283.19	408.01
		Variance	831.73	281.23	20.74	796.44	1,331.32
	T-Statistic		3.78 ^a	-0.22	0.08	-0.62	2.37 ^a

-Continued-

Table 7. (p 2 of 2).

River	Sex		S1FW	S2FW	SPGZ	S1FW+S2FW+ SPGZ	S10Z
Ugashik River	Male	Sample Size	86	86	75	86	86
		Mean	110.07	123.88	11.76	244.21	427.17
		Variance	300.47	321.99	21.86	584.54	1,096.99
	Female	Sample Size	114	114	99	114	114
		Mean	109.58	122.55	11.18	242.39	408.30
		Variance	338.88	253.35	24.79	432.52	1,222.39
	Combined	Sample Size	200	200	174	200	200
		Mean	109.79	123.13	11.79	243.17	416.42
		Variance	320.83	281.83	23.39	496.10	1,250.46
	T-Statistic		0.19	0.55	-0.06	0.57	3.87 ^a

^a Significant at $\alpha = 0.05$

Table 8. Classification matrices from discriminant analyses of age-2.2 sockeye salmon sampled from Kvichak, Naknek, Egegik, and Ugashik Rivers, 1990.

Actual Group Of Origin	Sample Size	Classified Group of Origin (%)			
		<u>Kvichak</u>	<u>Naknek</u>	<u>Egegik</u>	<u>Ugashik</u>
Kvichak	197	<u>87.3</u>	7.1	0.0	5.6
Naknek	197	9.6	<u>60.9</u>	15.7	13.7
Egegik	200	1.0	<u>14.5</u>	<u>76.5</u>	8.0
Ugashik	199	7.0	13.1	4.5	<u>75.4</u>

Mean classification accuracy = 75.0%

Variables used: 63,8,57,35,71,51,27,66,72,38,23

Box's Test of Variance-Covariance Equality^a

F-statistic = 3.32

D.F. = 198, 1,339,183

P = 0.00

Actual Group Of Origin	Sample Size	Classified Group of Origin (%)		
		<u>Kvichak</u>	<u>Naknek</u>	<u>Egegik</u>
Kvichak	197	<u>90.9</u>	8.6	0.5
Naknek	196	11.7	<u>68.4</u>	19.9
Egegik	200	1.0	14.5	<u>84.5</u>

Mean classification accuracy = 81.2%

Variables used: 63,71,65,57,35,73,104,80,51,10,18

Box's Test of Variance-Covariance Equality

F-statistic = 2.42

D.F. = 132, 933337

P = 0.00

-Continued-

Table 8. (p 2 of 4).

Actual Group Of Origin	Sample Size	Classified Group of Origin (%)		
		<u>Kvichak</u>	<u>Naknek</u>	<u>Ugashik</u>
Kvichak	197	<u>88.8</u>	6.1	5.1
Naknek	197	11.2	<u>74.6</u>	14.2
Ugashik	199	8.5	13.6	<u>77.9</u>

Mean classification accuracy = 80.4%
 Variables used: 63,8,57,71,51,65,72,15,18,10
 Box's Test of Variance-Covariance Equality
 F-statistic = 4.81
 D.F. = 110, 942,038
 P = 0.00

Actual Group Of Origin	Sample Size	Classified Group of Origin (%)		
		<u>Kvichak</u>	<u>Egegik</u>	<u>Ugashik</u>
Kvichak	197	<u>90.4</u>	0.5	9.1
Egegik	200	1.5	<u>88.5</u>	10.0
Ugashik	199	8.5	7.0	<u>84.4</u>

Mean classification accuracy = 87.8%
 Variables used: 63,8,35,57,71,66,10,14
 Box's Test of Variance-Covariance Equality
 F-statistic = 5.67
 D.F. = 72, 979,526
 P = 0.00

-Continued-

Table 8. (p 3 of 4).

Actual Group Of Origin	Sample Size	Classified Group of Origin (%)	
		<u>Kvichak</u>	<u>Naknek</u>
Kvichak	200	<u>92.0</u>	8.0
Naknek	200	12.5	<u>87.5</u>

Mean classification accuracy = 89.8%
 Variables used: 65,32,71,55,44
 Box's Test of Variance-Covariance Equality
 F-statistic = 3.75
 D.F. = 15, 637,785
 P = 0.00

Actual Group Of Origin	Sample Size	Classified Group of Origin (%)	
		<u>Kvichak</u>	<u>Egegik</u>
Kvichak	200	<u>99.0</u>	1.0
Egegik	200	3.0	<u>97.0</u>

Mean classification accuracy = 98.0%
 Variables used: 63,42,15,71
 Box's Test of Variance-Covariance Equality
 F-statistic = 13.87
 D.F. = 10, 757,309
 P = 0.01

-Continued-

Table 8. (p 4 of 4).

Actual Group Of Origin	Sample Size	Classified Group of Origin (%)	
		<u>Kvichak</u>	<u>Ugashik</u>
Kvichak	197	<u>91.9</u>	8.1
Ugashik	199	9.0	<u>91.0</u>

Mean classification accuracy = 91.4%

Variables used: 63,8,57,71,10,29

Box's Test of Variance-Covariance Equality

F-statistic = 2.44

D.F. = 21, 570,834

P = 0.00

^a The equality of the variance -covariance matrices tested with a procedure described by Box (1949).

Table 9. Mean and standard error of age-1.3 scale variables used to construct linear discriminant functions for the East Side of Bristol Bay, 1990.

Variable Number	Variable Name	Kvichak		Naknek		Egegik		Ugashik	
		Mean ^a	SE	Mean ^a	SE	Mean ^a	SE	Mean ^a	SE
<u>First Freshwater Annular Zone</u>									
11	C4-C8	42.98	0.697	44.39	0.478	48.03	0.486	43.20	0.597
14	C2-E1FW	88.48	2.647	108.54	2.023	153.00	1.786	108.05	2.283
16	C0-C2/S1FW	0.37	0.009	0.32	0.005	0.25	0.003	0.34	0.005
19	C0-C8/S1FW	0.87	0.015	0.77	0.008	0.63	0.006	0.77	0.008
24	C4-C8/S1FW	0.31	0.005	0.28	0.003	0.24	0.003	0.27	0.003
<u>Freshwater and Plus Growth Zones</u>									
66	S1FW+S2FW+SPGZ	146.43	2.541	171.11	2.125	215.09	1.661	174.90	2.463
<u>First Marine Annular Zone</u>									
77	C3-C6	54.33	2.044	49.23	1.024	63.40	1.310	56.56	1.254
96	C3-C9/S10Z	0.28	0.009	0.26	0.004	0.32	0.005	0.29	0.004

^a Scale images projected at 100x magnification and measured at 0.01 in; therefore, variable means are in 0.0001 in.

Table 10. Classification matrix from a discriminant analysis of age-1.3 sockeye salmon sampled from Kvichak, Naknek, Egegik, and Ugashik Rivers, 1990.

Actual Group Of Origin	Sample Size	Classified Group of Origin (%)			
		<u>Kvichak</u>	<u>Naknek</u>	<u>Egegik</u>	<u>Ugashik</u>
Kvichak	40	<u>75.0</u>	7.5	0.0	17.5
Naknek	100	12.0	<u>61.0</u>	7.0	20.0
Egegik	78	0.0	9.0	<u>85.9</u>	5.1
Ugashik	100	12.0	25.0	8.0	<u>55.0</u>

Mean classification accuracy = 69.2%

Variables used: 14,77,24,11,16,66,96,19

Box's Test of Variance-Covariance Equality^a

F-statistic = 4.43

D.F. = 108, 86,162

P = 0.00

^a The equality of the variance -covariance matrices tested with a procedure described by Box (1949).

Table 11. Mean and standard error of age-2.3 scale variables used to construct linear discriminant functions for the East Side of Bristol Bay, 1990.

Variable Number	Variable Name	Kvichak		Naknek		Egegik		Ugashik	
		Mean ^a	SE	Mean ^a	SE	Mean ^a	SE	Mean ^a	SE
<u>First Freshwater Annular Zone</u>									
2	S1FW	102.50	1.868	121.68	1.389	132.92	1.769	100.31	1.360
4	C0-C4	72.06	0.791	73.61	0.498	76.39	0.463	67.90	0.531
12	C(NC-4)-E1FW	36.27	0.506	34.78	0.332	34.29	0.301	31.06	0.315
17	C0-C4/S1FW	0.72	0.010	0.62	0.007	0.59	0.007	0.69	0.007
25	(C(NC-4)-E1FW)/S1FW	0.37	0.008	0.30	0.005	0.27	0.004	0.32	0.005
27	S1FW/NC1FW	13.81	0.132	13.31	0.086	13.35	0.075	12.39	0.083
<u>Second Freshwater Annular Zone</u>									
31	NC2FW	8.92	0.110	11.17	0.106	11.22	0.102	10.34	0.116
32	S2FW	90.26	1.204	118.61	1.282	119.04	1.082	108.26	1.335
38	C2-C6	45.37	0.433	48.17	0.364	47.55	0.322	47.47	0.400
40	C4-C6	21.49	0.304	23.43	0.240	23.59	0.200	23.53	0.248
43	C(NC-2)-E2FW	13.64	0.260	14.73	0.177	14.33	0.166	13.90	0.208
45	C4-E2FW	43.92	1.209	70.82	1.227	72.52	1.118	61.88	1.312
48	(E1FW-C6)/S2FW	0.76	0.009	0.61	0.006	0.60	0.006	0.66	0.008
<u>Freshwater and Plus Growth Zones</u>									
65	NC1FW+NC2FW+NCPG	16.78	0.156	21.33	0.136	22.13	0.132	19.49	0.129
67	S1FW/(S1FW+S2FW+SPGZ)	0.52	0.006	0.49	0.004	0.51	0.005	0.46	0.005
<u>First Marine Annular Zone</u>									
72	EFW-C3	51.33	0.906	46.42	0.533	50.67	0.661	44.87	0.592
88	C9-E10Z	232.12	3.788	236.31	2.479	218.85	2.355	250.71	2.877

^a Scale images projected at 100x magnification and measured in 0.01 in; therefore, variable means are in 0.0001 in.

Table 12. Mean, variance, and t-statistic comparing males and females for selected scale variables of age-2.3 sockeye salmon sampled from Kvichak, Naknek, Egegik, and Ugashik Rivers 1990.

River	Sex		S1FW	S2FW	SPGZ	S1FW+S2FW+ SPGZ	S1OZ	S2OZ
Kvichak	Male	Sample Size	55	55	21	55	55	55
		Mean	103.00	90.09	10.14	196.96	428.75	353.49
		Variance	376.07	195.86	7.63	543.33	1,322.60	3,057.92
	Female	Sample Size	52	52	19	52	52	52
		Mean	102.06	90.38	9.42	195.88	420.58	326.56
		Variance	391.70	120.63	2.59	401.44	1,480.72	2,147.08
	Combined	Sample Size	108 ^a	108 ^a	40	108 ^a	108 ^a	108 ^a
		Mean	102.50	90.26	9.80	196.39	424.57	340.19
		Variance	376.91	156.44	5.29	466.11	1,394.30	2,752.48
	T-Statistic		0.25	-0.12	1.00	0.26	1.13	2.72 ^b
Naknek	Male	Sample Size	67	67	55	67	67	67
		Mean	121.22	120.48	11.47	251.12	432.79	332.36
		Variance	394.60	386.13	12.99	541.29	1,106.96	1,791.48
	Female	Sample Size	133	133	109	133	133	133
		Mean	121.91	117.67	11.38	248.90	417.05	321.97
		Variance	384.04	300.04	12.35	617.42	1,229.07	1,388.80
	Combined	Sample Size	200	200	164	200	200	200
		Mean	121.68	118.61	11.41	249.65	422.33	325.45
		Variance	385.72	328.85	12.49	590.17	1,237.85	1,539.54
	T-Statistic		-0.23	1.03	0.16	0.61	3.05 ^b	1.78
Egegik	Male	Sample Size	101	101	73	101	101	101
		Mean	133.21	117.97	11.99	259.84	415.39	329.88
		Variance	690.37	273.33	17.85	483.25	1,309.38	1,562.41
	Female	Sample Size	99	99	74	99	99	99
		Mean	132.63	120.12	11.41	261.27	405.22	316.79
		Variance	566.69	193.76	20.82	676.81	959.13	1,712.01
	Combined	Sample Size	200	200	147	200	200	200
		Mean	132.92	119.04	11.69	260.55	410.36	323.40
		Variance	626.07	233.93	19.30	576.66	1,156.27	1,671.30
	T-Statistic		0.16	-0.99	0.80	-0.42	2.13 ^b	2.29 ^b

-Continued-

Table 12. (p 2 of 2).

River	Sex		S1FW	S2FW	SPGZ	S1FW+S2FW+ SPGZ	S10Z	S20Z
Ugashik	Male	Sample Size	68	68	49	68	68	68
		Mean	98.12	109.01	12.92	216.44	450.68	347.18
		Variance	320.73	366.01	29.20	494.34	1,452.13	1,778.12
	Female	Sample Size	95	95	81	95	95	95
		Mean	101.88	107.72	12.48	220.24	421.86	346.37
		Variance	285.21	239.38	25.80	401.29	1,126.40	1,655.38
	Combined	Sample Size	163	163	130	163	163	163
		Mean	100.31	108.26	12.65	218.66	433.88	346.71
		Variance	301.61	290.69	26.91	440.83	1,457.26	1,696.09
	T-Statistic		-1.37	0.48	0.46	-1.14	5.11 ^b	0.12

^a Included one sample for which sex was not determined.

^b Significant at $\alpha = 0.05$

Table 13. Classification matrices from discriminant analyses of age-2.3 sockeye salmon sampled from Kvichak, Naknek, Egegik, and Ugashik Rivers, 1990.

Actual Group Of Origin	Sample Size	Classified Group of Origin (%)			
		<u>Kvichak</u>	<u>Naknek</u>	<u>Egegik</u>	<u>Ugashik</u>
Kvichak	108	<u>80.6</u>	6.5	3.7	9.3
Naknek	200	3.0	<u>56.5</u>	26.5	14.0
Egegik	200	1.5	24.0	<u>67.0</u>	7.5
Ugashik	163	6.1	13.5	3.7	<u>76.7</u>

Mean classification accuracy = 70.2%

Variables used: 27,67,72,31,88,48,4,17,45,40,43,2,38

Box's Test of Variance-Covariance Equality^a

F-statistic = 5.04

D.F. = 273, 614,848

P = 0.01

Actual Group Of Origin	Sample Size	Classified Group of Origin (%)		
		<u>Kvichak</u>	<u>Naknek/Egegik^b</u>	<u>Ugashik</u>
Kvichak	108	<u>84.3</u>	6.5	9.3
Naknek/Egegik	400	3.2	<u>83.5</u>	13.2
Ugashik	163	4.9	12.9	<u>82.2</u>

Mean classification accuracy = 83.3%

Variables used: 65,27,67,72,25,12,32,88,2,48

Box's Test of Variance-Covariance Equality

F-statistic = 6.68

D.F. = 110, 326,312

P = 0.00

-Continued-

Table 13. (p 2 of 2).

Actual Group Of Origin	Sample Size	Classified Group of Origin (%)	
		<u>Kvichak</u>	<u>Naknek/Egegik</u>
Kvichak	108	<u>93.5</u>	6.5
Naknek/Egegik	400	7.0	<u>93.0</u>

Mean classification accuracy = 93.3%

Variables used: 65,67,43

Box's Test of Variance-Covariance Equality

F-statistic = 2.59

D.F. = 6, 228,120

P = 0.01

^a The equality of the variance -covariance matrices tested with a procedure described by Box (1949).

^b Samples from Naknek and Egegik Rivers were pooled.

Table 14. Run composition estimates and 90% confidence intervals (C.I.) calculated from scale pattern analyses of age-2.2 sockeye salmon by fishery and date for the East Side of Bristol Bay, 1990.

Fishery	Date	Kvichak		Naknek		Egegik		Ugashik	
		Pt. Est. ^a	90% C.I.	Pt. Est. ^a	90% C.I.	Pt. Est. ^a	90% C.I.	Pt. Est. ^a	90% C.I.
Naknek/ Kvichak	6/11-6/22	86.5	(78.0,94.9)	0.0	Trace ^b	13.5	(5.1,22.0)	0.0	Trace
	6/28-6/29	78.6	(69.1,88.2)	21.4	(11.8,30.9)	0.0	Trace	0.0	Trace
	6/30	74.8	(65.0,84.7)	25.2	(15.3,35.0)	0.0	Trace	0.0	Trace
	7/01-7/03	86.4	(78.2,94.5)	12.7	(2.5,23.0)	0.9	(0.0, 5.1)	0.0	Trace
	7/04-7/05	78.9	(66.9,91.0)	12.2	(0.0,26.5)	2.4	(0.0, 8.3)	6.5	(0.0, 16.3)
	7/06-7/09	88.1	(78.9,97.2)	10.0	(0.0,21.5)	1.9	(0.0, 6.8)	0.0	Trace
	7/10-7/11	81.0	(64.9,97.1)	16.1	(0.0,36.2)	2.2	(0.0,10.7)	0.7	(0.0, 12.2)
	7/12-7/14	78.6	(69.1,88.2)	21.4	(11.8,30.9)	0.0	Trace	0.0	Trace
	7/15-9/01	78.3	(62.3,94.4)	12.6	(0.0,31.6)	2.4	(0.0,10.6)	6.7	(0.0, 19.8)
Egegik	6/07-6/21	55.7	(42.6,68.7)	8.9	(0.0,23.8)	35.4	(21.6,49.3)	0.0	Trace
	6/22-6/30	55.5	(42.6,68.3)	1.4	(0.0,15.1)	43.1	(28.9,57.3)	0.0	Trace
	7/01-7/02	42.7	(34.1,51.3)	0.0	Trace	57.3	(48.7,65.9)	0.0	Trace
	7/03-7/04	33.8	(19.0,48.7)	0.8	(0.0,21.0)	64.5	(43.5,85.3)	0.9	(0.0, 12.9)
	7/05-7/06	39.6	(31.1,48.1)	0.0	Trace	60.4	(51.9,68.9)	0.0	Trace
	7/07-7/08	46.0	(32.7,59.3)	3.1	(0.0,18.2)	50.9	(35.1,66.6)	0.0	Trace
	7/10	37.9	(25.9,50.0)	0.0	Trace	60.1	(47.1,73.1)	2.0	(0.0, 12.0)
	7/12-7/13	35.6	(23.6,47.6)	0.0	Trace	51.9	(38.9,64.9)	12.5	(0.6, 24.4)
	7/14-7/15	33.5	(19.0,47.9)	11.3	(0.0,32.1)	47.4	(28.3,66.5)	7.8	(0.0, 21.4)
	7/16-9/06	18.8	(6.8,30.9)	0.9	(0.0,20.7)	62.8	(42.6,83.1)	17.5	(1.5, 33.4)
Ugashik	6/05-6/22	30.7	(10.5,50.9)	10.0	(0.0,38.5)	46.2	(19.6,72.8)	13.1	(0.0, 34.0)
	6/26-7/04	13.6	(0.0,27.4)	0.0	Trace	4.4	(0.0,15.0)	82.0	(64.5, 99.7)
	7/06-7/09	6.6	(0.0,16.3)	0.0	Trace	12.8	(2.2,23.4)	80.6	(66.3, 95.2)
	7/10-7/12	6.1	(0.0,16.0)	0.0	Trace	6.6	(0.0,16.1)	87.3	(73.4,100.0)
	7/13-7/15	8.3	(0.0,18.5)	0.0	Trace	12.3	(1.7,22.9)	79.4	(64.8, 94.2)
	7/16-9/07	8.4	(0.0,19.4)	0.0	Trace	0.0	Trace	91.6	(80.6,100.0)

^a Expressed in percent.

^b Trace was recorded for systems that were originally included in the model used to classify the catch, their point estimates were zero, but the upper bounds of the 90% confidence interval was greater than zero.

Table 15. Estimated numbers of age-2.2 sockeye salmon by river of origin harvested in the East Side of Bristol Bay, 1990.

District	River	Estimated Percent	Estimated Numbers	Standard Error of Estimate	Coefficient of Variation
Naknek/ Kvichak	Kvichak	82.4	6,344,297	167,074	2.6
	Naknek	14.2	1,096,598	172,643	15.7
	Egegik	1.6	120,726	68,339	56.6
	Ugashik	1.8	141,199	74,471	52.7
	Total	100.0	7,702,820		
Egegik	Kvichak	37.6	1,220,449	67,589	5.5
	Naknek	1.6	52,847	55,719	105.4
	Egegik	56.6	1,839,160	84,241	4.6
	Ugashik	4.2	136,284	40,416	29.7
	Total	100.0	3,248,740		
Ugashik	Kvichak	8.1	54,675	18,181	33.3
	Naknek	0.2	1,109	1,266	114.2
	Egegik	7.7	52,185	12,443	23.8
	Ugashik	84.0	565,496	31,411	5.6
	Total	100.0	673,465		
Total East Side	Kvichak	65.5	7,619,421	181,142	2.4
	Naknek	9.9	1,150,554	181,416	15.8
	Egegik	17.3	2,012,071	109,186	5.4
	Ugashik	7.3	842,979	90,366	10.7
	Total	100.0	11,625,025		

Table 16. Run composition estimates and 90% confidence intervals (C.I.) calculated from scale pattern analyses of age-2.3 sockeye salmon by fishery and date for the East Side of Bristol Bay, 1990.

Fishery	Date	Kvichak		Ugashik		Other ^a	
		Pt. Est. ^b	90% C.I.	Pt. Est. ^b	90% C.I.	Pt. Est. ^b	90% C.I.
Naknek/ Kvichak	6/11-6/29	79.2	(64.0, 94.3)	1.6	(0.0, 13.7)	19.2	(05.7, 32.6)
	6/30	56.9	(44.8, 69.1)	0.0	Trace ^c	43.1	(30.9, 55.2)
	7/01-7/03	58.4	(46.2, 70.6)	6.4	(0.0, 16.7)	35.2	(23.3, 47.1)
	7/04-7/05	51.0	(38.5, 63.5)	9.0	(0.0, 20.1)	40.0	(27.2, 52.8)
	7/06-7/09	47.7	(33.8, 61.7)	5.3	(0.0, 17.1)	47.0	(32.2, 61.8)
	7/10-8/17	42.7	(30.6, 54.6)	6.3	(0.0, 17.0)	51.0	(37.9, 64.2)
Egegik	6/07-6/30	16.2	(8.1, 24.2)	0.0	Trace	83.8	(75.8, 91.9)
	7/01-7/02	10.4	(3.1, 17.7)	0.0	Trace	89.6	(82.3, 96.9)
	7/03-7/04	11.6	(4.1, 19.0)	0.0	Trace	88.4	(81.0, 95.9)
	7/05-7/06	4.6	(0.0, 11.0)	0.0	Trace	95.4	(89.0, 100.0)
	7/07-7/08	8.1	(1.1, 15.1)	0.0	Trace	91.9	(84.9, 98.9)
	7/10	8.1	(1.1, 15.1)	0.0	Trace	91.9	(84.9, 98.9)
	7/12-7/13	5.8	(0.0, 12.4)	0.0	Trace	94.2	(87.6, 100.0)
	7/14-7/15	8.8	(1.3, 16.3)	0.0	Trace	91.2	(83.7, 98.7)
	7/16-9/06	0.0	Trace	0.0	Trace	100.0	(97.5, 100.0)
Ugashik	6/05-7/04	3.8	(0.0, 11.0)	43.4	(27.3, 59.4)	52.8	(37.1, 68.6)
	7/06-7/09	7.6	(0.0, 16.2)	50.7	(34.4, 67.2)	41.7	(26.0, 57.4)
	7/10-7/12	15.4	(4.5, 26.4)	55.8	(38.8, 72.8)	28.8	(13.3, 44.3)
	7/13-9/07	6.3	(0.0, 14.3)	42.1	(26.1, 58.0)	51.6	(36.0, 67.4)

^a Represents samples from Naknek and Egegik Rivers.

^b Expressed in percent.

^c Trace was recorded for systems that were originally included in the model used to classify the catch, their point estimates were zero, but the upper bounds of the 90% confidence interval was greater than zero.

Table 17. Estimated numbers of age-2.3 sockeye salmon by river of origin harvested in the East Side of Bristol Bay, 1990.

District	River	Estimated Percent	Estimated Numbers	Standard Error of Estimate	Coefficient of Variation
Naknek/ Kvichak	Kvichak	51.3	1,793,231	92,924	5.2
	Ugashik	6.0	209,052	70,568	33.8
	Other ^a	42.7	1,489,075	93,698	6.3
	Total	100.0	3,491,358		
Egegik	Kvichak	7.3	307,466	62,852	20.4
	Ugashik	0.0	0	0	
	Other	92.7	3,885,294	94,500	2.4
	Total	100.0	4,192,760		
Ugashik	Kvichak	8.3	49,172	11,951	24.3
	Ugashik	48.2	284,451	24,371	8.6
	Other	43.5	257,067	23,448	9.1
	Total	100.0	590,690		
Total East Side	Kvichak	26.0	2,149,869	112,819	5.2
	Ugashik	6.0	493,503	74,658	15.1
	Other	68.0	5,631,436	135,127	2.4
	Total	100.0	8,274,808		

^a Represents samples from Egegik and Naknek Rivers.

Table 18. Run composition estimates of sockeye salmon catch by age group and date, Naknek-Kvichak District, 1990.

Date	System	0.2		0.3		1.2		1.3		2.2		2.3		Other ^a		Total	
		%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number
6/11 ^b	Kvichak	84.8	469	75.4	835	23.0	1,144	66.9	59,587	86.5	49,302	79.2	25,857	0.0	0	74.0	137,193
	thru Naknek	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
6/22	Egegik	11.9	66	2.7	30	74.3	3,702	27.0	24,062	13.5	7,694	19.2	6,268	0.0	0	22.6	41,822
	Ugashik	3.3	18	21.9	242	2.7	134	6.1	5,442	0.0	0	1.6	522	0.0	0	3.4	6,359
	Total	100.0	553	100.0	1,107	100.0	4,980	100.0	89,090	100.0	56,996	100.0	32,648	0.0	0	100.0	185,374
6/28	Kvichak	0.0	0	0.0	0	11.3	8,463	15.3	25,047	78.6	326,868	79.2	127,144	0.0	0	59.9	487,522
	thru Naknek	0.0	0	0.0	0	87.6	65,643	83.6	136,684	21.4	88,995	19.2	30,823	0.0	0	39.5	322,145
6/29	Egegik	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	Ugashik	0.0	0	0.0	0	1.1	810	1.1	1,862	0.0	0	1.6	2,569	0.0	0	0.6	5,240
	Total	0.0	0	0.0	0	100.0	74,916	100.0	163,593	100.0	415,863	100.0	160,535	0.0	0	100.0	814,907
6/30	Kvichak	0.0	0	60.1	1,100	6.9	5,806	9.5	26,149	74.8	291,592	56.9	119,757	0.0	0	46.3	444,405
	Naknek	0.0	0	39.9	730	93.1	78,382	90.5	248,378	25.2	98,237	43.1	90,713	0.0	0	53.7	516,439
	Egegik	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	Ugashik	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	Total	0.0	0	100.0	1,830	100.0	84,188	100.0	274,527	100.0	389,829	100.0	210,470	0.0	0	100.0	960,844
7/01	Kvichak	77.1	1,432	41.0	2,283	11.2	19,960	15.6	96,066	86.4	1,281,342	58.4	398,315	0.0	0	60.4	1,799,398
	thru Naknek	10.7	198	14.4	803	80.1	142,959	78.5	484,100	12.7	188,345	32.4	220,983	74.7	5,551	35.1	1,042,939
7/03	Egegik	1.1	21	0.2	9	3.8	6,717	0.7	4,033	0.9	13,347	2.8	19,097	25.3	1,882	1.5	45,107
	Ugashik	11.2	208	44.5	2,480	4.9	8,774	5.3	32,803	0.0	0	6.4	43,651	0.0	0	3.0	87,916
	Total	100.0	1,858	100.0	5,575	100.0	178,410	100.0	617,002	100.0	1,483,035	100.0	682,047	100.0	7,433	100.0	2,975,360
7/04	Kvichak	55.6	1,627	17.0	498	8.3	15,050	12.1	93,611	78.9	995,588	51.0	347,897	0.0	0	49.7	1,454,270
	thru Naknek	8.8	257	6.8	200	67.8	122,998	69.4	538,284	12.2	153,944	32.2	219,653	56.4	11,567	35.8	1,046,903
7/05	Egegik	2.6	76	0.2	6	9.0	16,295	1.6	12,645	2.4	30,284	7.8	53,208	43.6	8,926	4.1	121,440
	Ugashik	33.1	969	75.9	2,224	15.0	27,174	16.9	131,298	6.5	82,019	9.0	61,394	0.0	0	10.4	305,077
	Total	100.0	2,928	100.0	2,928	100.0	181,517	100.0	775,838	100.0	1,261,835	100.0	682,151	100.0	20,493	100.0	2,927,690

-Continued-

Table 18. (p 2 of 2).

Date	System	0.2		0.3		1.2		1.3		2.2		2.3		Other ^a		Total	
		%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number
7/06	Kvichak	0.0	0	44.2	3,799	10.5	40,877	15.4	134,778	88.1	1,522,979	47.7	365,599	0.0	0	54.8	2,068,030
thru	Naknek	0.0	0	15.7	1,350	75.9	295,729	78.4	686,037	10.0	172,869	38.1	292,019	55.1	2,512	38.4	1,450,516
7/09	Egegik	0.0	0	0.5	39	9.8	38,109	1.8	15,676	1.9	32,845	8.9	68,214	44.9	2,050	4.2	156,935
	Ugashik	0.0	0	39.7	3,415	3.8	14,872	4.4	38,091	0.0	0	5.3	40,622	0.0	0	2.6	97,000
	Total	0.0	0	100.0	8,603	100.0	389,587	100.0	874,582	100.0	1,728,693	100.0	766,454	100.0	4,562	100.0	3,772,481
7/10	Kvichak	0.0	0	0.0	0	7.9	18,169	11.5	37,716	81.0	638,113	42.7	138,410	0.0	0	49.7	832,407
thru	Naknek	0.0	0	0.0	0	80.4	184,629	82.1	269,653	16.1	126,835	43.7	141,651	66.0	2,706	43.3	725,475
7/11	Egegik	0.0	0	0.0	0	7.3	16,711	1.3	4,328	2.2	17,331	7.3	23,663	28.7	1,178	3.8	63,211
	Ugashik	0.0	0	0.0	0	4.5	10,265	5.0	16,552	0.7	5,515	6.3	20,421	5.3	219	3.2	52,971
	Total	0.0	0	0.0	0	100.0	229,774	100.0	328,248	100.0	787,794	100.0	324,145	100.0	4,103	100.0	1,674,064
7/12	Kvichak	69.4	1,143	33.4	664	6.5	20,957	9.0	35,568	78.6	611,357	42.7	165,656	0.0	0	44.3	835,344
thru	Naknek	18.5	304	22.6	449	90.0	288,777	87.3	344,833	21.4	166,451	51.0	197,856	0.0	0	52.9	998,670
7/14	Egegik	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	100.0	1,986	0.1	1,986
	Ugashik	12.2	201	43.9	873	3.5	11,150	3.7	14,700	0.0	0	6.3	24,441	0.0	0	2.7	51,365
	Total	100.0	1,648	100.0	1,986	100.0	320,884	100.0	395,101	100.0	777,808	100.0	387,952	100.0	1,986	100.0	1,887,365
7/15 ^c	Kvichak	57.9	6,751	0.0	0	8.5	44,374	12.4	43,280	78.3	627,157	42.7	104,596	0.0	0	42.8	826,160
thru	Naknek	9.1	1,059	0.0	0	69.2	360,611	70.7	247,463	12.6	100,922	41.4	101,412	0.0	0	42.1	811,465
8/17	Egegik	2.6	297	0.0	0	8.7	45,155	1.6	5,495	2.4	19,223	9.6	23,516	0.0	0	4.9	93,686
	Ugashik	30.5	3,557	0.0	0	13.6	70,876	15.3	53,699	6.7	53,665	6.3	15,432	0.0	0	10.2	197,229
	Total	100.0	11,664	0.0	0	100.0	521,016	100.0	349,937	100.0	800,967	100.0	244,956	0.0	0	100.0	1,928,540
Total	Kvichak	61.3	11,422	41.7	9,179	8.8	174,799	14.3	551,801	82.4	6,344,297	51.3	1,793,231	0.0	0	51.8	8,884,729
	Naknek	9.7	1,817	16.0	3,532	77.5	1,539,728	76.4	2,955,432	14.2	1,096,598	37.1	1,295,109	57.9	22,336	40.4	6,914,552
	Egegik	2.5	460	0.4	84	6.4	126,690	1.7	66,239	1.6	120,726	5.6	193,966	41.5	16,022	3.1	524,187
	Ugashik	26.5	4,952	41.9	9,234	7.3	144,055	7.6	294,446	1.8	141,199	6.0	209,052	0.6	219	4.7	803,157
	Total	100.0	18,651	100.0	22,029	100.0	1,985,272	100.0	3,867,918	100.0	7,702,820	100.0	3,491,358	100.0	38,577	100.0	17,126,625

^a Other includes ages 2.1, 1.4, 3.2, and 3.3.

^b Scale samples were collected from 20 June through 21 June. Stock composition estimates calculated from those dates were applied to 11 June through 22 June catches.

^c Scale samples were collected on 15 July. Stock composition estimates calculated from that date were applied to 15 July through 17 August catches.

Table 19. Run composition estimates of sockeye salmon setnet catch from selected beaches, Naknek Section, Naknek-Kvichak District, 1990.

Beach	Date	Percent Classification by Stock				Total
		Kvichak	Naknek	Egegik	Ugashik	
Libbyville	7/07	25.0	75.0	0.0	0.0	100.0
to	7/08	15.8	84.2	0.0	0.0	100.0
Pederson Pt.	7/09	41.2	58.8	0.0	0.0	100.0
	7/10	14.9	63.6	0.0	21.5	100.0
Pederson Pt.	7/07	12.8	87.2	0.0	0.0	100.0
to	7/08	10.4	89.6	0.0	0.0	100.0
Inside Marker	7/09	19.1	75.7	5.2	0.0	100.0
	7/10	9.4	85.1	5.5	0.0	100.0
South Naknek	7/12	51.1	34.3	6.5	8.1	100.0
Beach	7/13	48.9	37.5	9.6	4.0	100.0

Table 20. Run composition estimates of sockeye salmon catch by age group and date, Egegik District, 1990.

Date	System	1.2		1.3		2.2		2.3		3.2		2.4		3.3		Other ^a		Total	
		%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number
6/07 ^b	Kvichak	3.4	377	10.9	1,674	55.7	18,219	16.2	3,271	0.0	0	0.0	0	0.0	0	46.8	391	29.8	23,932
thru	Naknek	26.7	2,986	60.8	9,342	8.9	2,911	14.3	2,888	0.0	0	0.0	0	0.0	0	17.4	145	22.8	18,271
6/21	Egegik	69.9	7,819	28.3	4,337	35.4	11,579	69.5	14,034	0.0	0	0.0	0	0.0	0	35.8	299	47.4	38,068
	Ugashik	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	Total	100.0	11,181	100.0	15,353	100.0	32,709	100.0	20,193	0.0	0	0.0	0	0.0	0	100.0	835	100.0	80,271
6/22	Kvichak	3.9	2,128	21.1	13,238	55.5	93,432	16.2	14,372	0.0	0	0.0	0	0.0	0	37.9	530	32.9	123,701
thru	Naknek	4.6	2,500	17.4	10,941	1.4	2,357	2.2	1,952	0.0	0	0.0	0	0.0	0	19.7	275	4.8	18,024
6/30	Egegik	91.5	49,857	61.5	38,689	43.1	72,557	81.6	72,391	0.0	0	0.0	0	0.0	0	42.4	593	62.3	234,086
	Ugashik	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	Total	100.0	54,485	100.0	62,868	100.0	168,346	100.0	88,714	0.0	0	0.0	0	0.0	0	100.0	1,398	100.0	375,811
7/01	Kvichak	2.1	3,929	14.6	25,771	42.7	182,467	10.4	41,543	0.0	0	16.8	1,172	0.0	0	32.9	3,054	21.3	257,936
thru	Naknek	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
7/02	Egegik	97.9	184,185	85.4	150,731	57.3	244,856	89.6	357,909	100.0	2,322	83.2	5,795	0.0	0	67.1	6,235	78.7	952,033
	Ugashik	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	Total	100.0	188,114	100.0	176,502	100.0	427,323	100.0	399,452	100.0	2,322	100.0	6,967	0.0	0	100.0	9,289	100.0	1,209,969
7/03	Kvichak	1.4	2,029	9.3	16,291	33.8	108,886	11.6	62,187	0.0	0	12.1	1,189	0.0	0	0.0	0	15.9	190,583
thru	Naknek	1.8	2,581	8.3	14,576	0.8	2,577	0.9	4,825	0.0	0	0.0	0	0.0	0	0.0	0	2.1	24,559
7/04	Egegik	96.4	139,899	80.2	140,105	64.5	207,786	87.5	469,085	100.0	4,918	87.9	8,647	100.0	2,459	0.0	0	81.4	972,899
	Ugashik	0.4	582	2.1	3,628	0.9	2,899	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.6	7,109
	Total	100.0	145,091	100.0	174,600	100.0	322,149	100.0	536,097	100.0	4,918	100.0	9,836	100.0	2,459	0.0	0	100.0	1,195,150
7/05	Kvichak	1.3	2,721	9.5	22,181	39.6	240,381	4.6	41,809	0.0	0	0.0	0	0.0	0	0.0	0	15.4	307,092
thru	Naknek	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
7/06	Egegik	98.7	207,276	90.5	210,784	60.4	366,641	95.4	867,083	100.0	39,374	0.0	0	0.0	0	0.0	0	84.6	1,691,158
	Ugashik	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	Total	100.0	209,997	100.0	232,965	100.0	607,022	100.0	908,892	100.0	39,374	0.0	0	0.0	0	0.0	0	100.0	1,998,250
7/07	Kvichak	1.6	2,174	8.7	18,206	46.0	184,516	8.1	51,161	0.0	0	0.0	0	0.0	0	0.0	0	18.2	256,057
thru	Naknek	8.1	10,905	30.7	64,256	3.1	12,435	4.4	27,791	0.0	0	0.0	0	0.0	0	0.0	0	8.2	115,387
7/08	Egegik	90.3	121,626	60.6	127,079	50.9	204,171	87.5	552,664	100.0	20,954	0.0	0	100.0	5,986	0.0	0	73.6	1,032,480
	Ugashik	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	Total	100.0	134,705	100.0	209,541	100.0	401,122	100.0	631,616	100.0	20,954	0.0	0	100.0	5,986	0.0	0	100.0	1,403,924

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Table 20. (p 2 of 2).

Date	System	1.2		1.3		2.2		2.3		3.2		2.4		3.3		Other ^a		Total	
		%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number
7/10	Kvichak	1.4	2,000	9.6	7,629	37.9	131,800	8.1	45,556	0.0	0	11.7	504	0.0	0	0.0	0	16.0	187,489
	Naknek	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	Egegik	97.7	142,645	85.4	67,866	60.1	209,002	91.9	516,863	100.0	32,200	88.3	3,790	0.0	0	100.0	2,147	83.0	974,513
	Ugashik	0.9	1,327	4.9	3,931	2.0	6,955	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	1.0	12,213
	Total	100.0	145,972	100.0	79,426	100.0	347,757	100.0	562,419	100.0	32,200	100.0	4,294	0.0	0	100.0	2,147	100.0	1,174,215
7/12	Kvichak	1.1	1,033	6.7	10,273	35.6	97,603	5.8	28,427	0.0	0	0.0	0	0.0	0	5.6	424	13.3	137,759
	thru Naknek	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
7/13	Egegik	93.7	86,232	69.5	107,008	51.9	142,292	94.2	461,687	100.0	9,389	0.0	0	100.0	5,634	30.2	2,271	78.9	814,512
	Ugashik	5.2	4,750	23.8	36,704	12.5	34,271	0.0	0	0.0	0	0.0	0	0.0	0	64.1	4,817	7.8	80,542
	Total	100.0	92,015	100.0	153,984	100.0	274,165	100.0	490,114	100.0	9,389	0.0	0	100.0	5,634	100.0	7,512	100.0	1,032,813
7/14	Kvichak	1.4	1,321	4.6	2,339	33.5	85,535	8.8	19,140	0.0	0	0.0	0	0.0	0	9.7	153	17.3	108,488
	thru Naknek	24.9	22,727	56.1	28,308	11.3	28,852	14.9	32,408	0.0	0	0.0	0	0.0	0	8.2	129	17.9	112,424
7/15	Egegik	69.0	63,113	27.6	13,940	47.4	121,025	76.3	165,955	100.0	11,032	0.0	0	0.0	0	5.1	81	59.8	375,146
	Ugashik	4.7	4,252	11.6	5,848	7.8	19,916	0.0	0	0.0	0	0.0	0	0.0	0	77.0	1,214	5.0	31,229
	Total	100.0	91,413	100.0	50,435	100.0	255,328	100.0	217,503	100.0	11,032	0.0	0	0.0	0	100.0	1,576	100.0	627,287
7/16 ^c	Kvichak	0.7	855	3.1	1,882	18.8	77,610	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	8.1	80,345
	thru Naknek	1.9	2,514	6.5	3,895	0.9	3,715	1.2	4,053	0.0	0	0.0	0	0.0	0	0.0	0	1.4	14,178
9/06	Egegik	87.1	113,774	52.0	31,252	62.8	259,250	98.8	333,707	100.0	46,536	0.0	0	100.0	1,501	0.0	0	79.5	786,022
	Ugashik	10.3	13,458	38.3	23,017	17.5	72,243	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	11.0	108,718
	Total	100.0	130,601	100.0	60,046	100.0	412,819	100.0	337,760	100.0	46,536	0.0	0	100.0	1,501	0.0	0	100.0	989,263
Total	Kvichak	1.5	18,567	9.8	119,484	37.6	1,220,449	7.3	307,466	0.0	0	13.6	2,865	0.0	0	20.0	4,551	16.6	1,673,382
	Naknek	3.7	44,213	10.8	131,318	1.6	52,847	1.8	73,916	0.0	0	0.0	0	0.0	0	2.4	549	3.0	302,843
	Egegik	92.8	1,116,425	73.4	891,791	56.6	1,839,160	90.9	3,811,378	100.0	166,725	86.4	18,232	100.0	15,580	51.1	11,626	78.0	7,870,917
	Ugashik	2.0	24,369	6.0	73,127	4.2	136,284	0.0	0	0.0	0	0.0	0	0.0	0	26.5	6,031	2.4	239,811
	Total	100.0	1,203,574	100.0	1,215,720	100.0	3,248,740	100.0	4,192,760	100.0	166,725	100.0	21,097	100.0	15,580	100.0	22,757	100.0	10,086,953

^a Other includes ages 0.2, 0.3, 2.1, and 1.4.

^b Scale samples were collected from 21 June. Stock composition estimates calculated for that date were applied to 7 June through 21 June catches.

^c Scale samples were collected on 16 and 18 July. Stock composition estimates calculated for those dates were applied to 16 July through 6 September catches.

Table 21. Run composition estimates of sockeye salmon setnet catch from selected beaches, Egegik District, 1990.

Beach	Date	Percent Classification by Stock				Total
		Kvichak	Naknek	Egegik	Ugashik	
Big Creek	7/02	2.6	0.0	97.4	0.0	100.0
to	7/03	2.4	15.4	82.2	0.0	100.0
Bishop Creek	7/06	7.0	0.0	88.5	4.5	100.0
	7/07	0.8	20.5	78.7	0.0	100.0
Bishop Creek	7/02	2.7	0.0	97.3	0.0	100.0
to	7/03	0.9	0.0	99.1	0.0	100.0
Coffee Point	7/06	10.4	6.7	82.9	0.0	100.0
Coffee Point	7/06	0.0	0.0	100.0	0.0	100.0
to	7/07	1.1	11.1	85.4	2.4	100.0
King Salmon River						

Table 22. Run composition estimates of sockeye salmon catch by age group and date, Ugashik District, 1990.

Date	System	0.2		0.3		1.2		1.3		2.2		1.4		2.3		3.2		2.4		Total	
		%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number
6/05 ^a	Kvichak	10.2	44	1.9	161	1.3	106	3.2	423	30.7	3,405	0.0	0	3.8	265	0.0	0	0.0	0	9.2	4,402
thru	Naknek	2.6	11	1.2	105	17.9	1,403	29.9	3,954	10.0	1,109	0.0	0	7.9	550	0.0	0	0.0	0	14.8	7,132
6/22	Egegik	17.4	74	0.8	70	52.9	4,134	15.6	2,067	46.2	5,124	0.0	0	44.9	3,128	0.0	0	0.0	0	30.4	14,597
	Ugashik	69.7	298	96.1	8,195	27.8	2,178	51.3	6,779	13.1	1,453	0.0	0	43.4	3,024	0.0	0	0.0	0	45.6	21,927
	Total	100.0	427	100.0	8,531	100.0	7,820	100.0	13,223	100.0	11,090	0.0	0	100.0	6,967	0.0	0	0.0	0	100.0	48,058
6/26	Kvichak	0.0	0	0.3	8	0.5	148	0.9	744	13.6	5,240	0.0	0	3.8	2,419	0.0	0	0.0	0	3.9	8,558
thru	Naknek	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
7/04	Egegik	0.0	0	0.3	7	37.9	11,893	8.9	7,452	4.4	1,695	100.0	419	52.8	33,610	0.0	0	0.0	0	25.0	55,078
	Ugashik	0.0	0	99.4	2,497	61.7	19,368	90.2	75,563	82.0	31,594	0.0	0	43.4	27,627	0.0	0	0.0	0	71.1	156,649
	Total	0.0	0	100.0	2,512	100.0	31,410	100.0	83,759	100.0	38,529	100.0	419	100.0	63,656	0.0	0	0.0	0	100.0	220,285
7/06	Kvichak	1.8	46	0.3	26	0.4	503	0.8	1,583	6.6	12,848	0.0	0	7.6	16,236	0.0	0	0.0	0	4.2	31,243
thru	Naknek	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
7/09	Egegik	5.4	136	0.2	20	30.6	34,370	6.6	13,490	12.8	24,918	100.0	3,792	41.7	89,083	0.0	0	0.0	0	22.3	165,809
	Ugashik	92.8	2,346	99.5	10,066	69.0	77,629	92.6	189,710	80.6	156,902	0.0	0	50.7	108,310	0.0	0	0.0	0	73.5	544,963
	Total	100.0	2,528	100.0	10,112	100.0	112,503	100.0	204,783	100.0	194,668	100.0	3,792	100.0	213,629	0.0	0	0.0	0	100.0	742,015
7/10	Kvichak	0.0	0	0.4	10	0.7	253	1.1	791	6.1	7,338	0.0	0	15.4	18,525	0.0	0	24.8	179	7.6	27,096
thru	Naknek	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
7/12	Egegik	0.0	0	0.1	3	20.2	7,262	3.9	2,829	6.6	7,939	100.0	2,161	28.8	34,644	100.0	1,440	75.2	541	15.9	56,820
	Ugashik	0.0	0	99.5	2,867	79.1	28,501	95.0	69,132	87.3	105,014	0.0	0	55.8	67,123	0.0	0	0.0	0	76.5	272,637
	Total	0.0	0	100.0	2,881	100.0	36,016	100.0	72,752	100.0	120,291	100.0	2,161	100.0	120,292	100.0	1,440	100.0	720	100.0	356,553
7/13	Kvichak	0.0	0	0.3	4	0.5	164	0.8	332	8.3	8,441	0.0	0	6.3	5,298	0.0	0	0.0	0	5.4	14,239
thru	Naknek	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
7/15	Egegik	0.0	0	0.2	3	33.0	11,613	7.3	2,932	12.3	12,509	0.0	0	51.6	43,396	100.0	1,467	0.0	0	27.2	71,921
	Ugashik	0.0	0	99.5	1,460	66.5	23,427	91.9	36,829	79.4	80,752	0.0	0	42.1	35,406	0.0	0	0.0	0	67.4	177,873
	Total	0.0	0	100.0	1,467	100.0	35,204	100.0	40,093	100.0	101,702	0.0	0	100.0	84,100	100.0	1,467	0.0	0	100.0	264,033

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Table 22. (p 2 of 2).

Date	System	0.2		0.3		1.2		1.3		2.2		1.4		2.3		3.2		2.4		Total	
		%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number
7/16 ^b	Kvichak	0.0	0	0.0	0	0.5	468	0.7	761	8.4	17,404	0.0	0	6.3	6,429	0.0	0	0.0	0	4.9	25,062
thru	Naknek	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
9/07	Egegik	0.0	0	0.0	0	18.8	18,028	3.6	3,654	0.0	0	100.0	6,185	51.6	52,656	0.0	0	0.0	0	15.7	80,523
	Ugashik	0.0	0	0.0	0	80.7	77,365	95.7	97,631	91.6	189,781	0.0	0	42.1	42,961	0.0	0	0.0	0	79.4	407,739
	Total	0.0	0	0.0	0	100.0	95,862	100.0	102,046	100.0	207,185	100.0	6,185	100.0	102,046	0.0	0	0.0	0	100.0	513,324
Total	Kvichak	3.0	90	0.8	209	0.5	1,642	0.9	4,633	8.1	54,675	0.0	0	8.3	49,172	0.0	0	24.8	179	5.2	110,600
	Naknek	0.4	11	0.4	105	0.4	1,403	0.8	3,954	0.2	1,109	0.0	0	0.1	550	0.0	0	0.0	0	0.3	7,132
	Egegik	7.1	211	0.4	103	27.4	87,302	6.3	32,425	7.7	52,185	100.0	12,557	43.4	256,517	100.0	2,907	75.2	541	20.7	444,748
	Ugashik	89.5	2,643	98.4	25,086	71.7	228,468	92.0	475,644	84.0	565,496	0.0	0	48.2	284,451	0.0	0	0.0	0	73.8	1,581,788
	Total	100.0	2,955	100.0	25,503	100.0	318,815	100.0	516,656	100.0	673,465	100.0	12,557	100.0	590,690	100.0	2,907	100.0	720	100.0	2,144,268

^a Scale samples were collected from 22 June. Stock composition estimates calculated from that date were applied to 5 June through 22 June catches.

^b Scale samples were collected from 17 July. Stock composition estimates calculated from that date were applied to 16 July through 7 September catches.

Table 23. Catch of sockeye salmon by run and district for the East Side of Bristol Bay, 1990.

		Catch by District			Total
Run		Naknek/Kvichak	Egegik	Ugashik	
Kvichak	Numbers	8,884,729	1,673,382	110,600	10,668,711
	Percent	83.3	15.7	1.0	100.0
Naknek	Numbers	6,914,552	302,843	7,132	7,224,527
	Percent	95.7	4.2	0.1	100.0
Egegik	Numbers	524,187	7,870,917	444,748	8,839,852
	Percent	5.9	89.1	5.0	100.0
Ugashik	Numbers	803,157	239,811	1,581,788	2,624,756
	Percent	30.6	9.1	60.3	100.0
Total East Side	Numbers	17,126,625	10,086,953	2,144,268	29,357,846
	Percent	58.3	34.4	7.3	100.0

Table 24. Percentages of sockeye salmon by run and age group for the East Side of Bristol Bay, 1990.

Run		0.2	1.1	0.3	1.2	2.1	0.4	1.3	2.2	1.4	2.3	3.2	2.4	3.3	Total
Kvichak	Escapement	0.06	0.02	0.05	1.20			1.33	34.59		2.26		0.01		39.52
	In District Catch	0.06		0.05	0.99			3.13	35.97		10.17				50.37
	Other Dist. Catch	0.00 ^a		0.03	0.11			0.70	7.23		2.02		0.02		10.11
	Total Run	0.12	0.02	0.13	2.30			5.16	77.79		14.45		0.03		100.00
Naknek	Escapement	0.01		0.02	6.30	0.02	0.01	6.86	6.20	0.02	3.02				22.46
	In District Catch	0.02		0.04	16.53	0.03		31.72	11.77	0.21	13.90				74.21
	Other Dist. Catch	0.00 ^a		0.00 ^a	0.49	0.00 ^a		1.45	0.58	0.00 ^a	0.80				3.33
	Total Run	0.03		0.06	23.32	0.05	0.01	40.03	18.55	0.23	17.72				100.00
Egegik	Escapement	0.02		0.00 ^a	5.02	0.09		1.04	8.33	0.00 ^a	4.97	0.38	0.01	0.00 ^a	19.87
	In District Catch	0.00 ^a		0.02	10.12	0.00 ^a		8.08	16.67	0.08	34.55	1.51	0.17	0.14	71.35
	Other Dist. Catch	0.01		0.00 ^a	1.94	0.01		0.89	1.57	0.12	4.08	0.14	0.00 ^a	0.02	8.78
	Total Run	0.03		0.03	17.08	0.10		10.01	26.57	0.21	43.60	2.03	0.18	0.16	100.00
Ugashik	Escapement	0.11	0.01	0.57	4.81	0.02		5.21	8.23		2.79				21.76
	In District Catch	0.08		0.75	6.81			14.18	16.86		8.48				47.15
	Other Dist. Catch	0.15		0.46	5.02	0.01		10.96	8.27		6.23				31.09
	Total Run	0.33	0.01	1.77	16.65	0.03		30.35	33.36		17.50				100.00

^a Represented < 0.01%

Table 25. Numbers of sockeye salmon by run and age group for the East Side of Bristol Bay, 1990.

Run	0.2	1.1	0.3	1.2	2.1	0.4	1.3	2.2	1.4	2.3	3.2	2.4	3.3	Total
Kvichak Escapement	11,107	3,530	8,060	211,062			234,020	6,101,908		397,935		2,398		6,970,020
In District Catch	11,422		9,179	174,799			551,801	6,344,297		1,793,231				8,884,729
Other Dist. Catch	171		4,679	20,209			124,117	1,275,124		356,638		3,044		1,783,982
Total Run	22,700	3,530	21,918	406,070			909,938	13,721,330		2,547,804		5,442		17,638,731
Naknek Escapement	836		1,540	587,225	2,065	587	639,524	577,631	1,706	281,464				2,092,578
In District Catch	1,817		3,532	1,539,728	2,706		2,955,432	1,096,598	19,630	1,295,109				6,914,552
Other Dist. Catch	24		385	45,616	12		135,272	53,956	244	74,466				309,975
Total Run	2,677		5,457	2,172,569	4,783	587	3,730,228	1,728,185	21,580	1,651,039				9,317,105
Egegik Escapement	1,890		349	553,754	10,039		114,787	918,871	164	548,009	42,159	991	349	2,191,362
In District Catch	73		2,273	1,116,425	155		891,791	1,839,160	9,125	3,811,378	166,725	18,232	15,580	7,870,917
Other Dist. Catch	671		187	213,992	1,178		98,664	172,911	12,754	450,483	15,534	541	2,020	968,935
Total Run	2,634		2,809	1,884,171	11,372		1,105,242	2,930,942	22,043	4,809,870	224,418	19,764	17,949	11,031,214
Ugashik Escapement	3,527	492	19,161	161,531	743		174,878	276,080		93,626				730,038
In District Catch	2,643		25,086	228,468			475,644	565,496		284,451				1,581,788
Other Dist. Catch	4,952		15,265	168,424	219		367,573	277,483		209,052				1,042,968
Total Run	11,122	492	59,512	558,423	962		1,018,095	1,119,059		587,129				3,354,794

Table 26. Comparison of sockeye salmon run estimates for the East Side of Bristol Bay, 1990.

Stock	Estimated Run		Difference
	Standard Method ^a	Scale Pattern Analysis	
Kvichak	17,575,819	17,638,731	- 62,912
Naknek	8,613,404	9,317,105	- 703,701
Egegik	12,278,315	11,031,214	1,247,101
Ugashik	2,874,306	3,354,794	- 480,488
Total East Side	41,341,844	41,341,844	

^a Standard method assumes fish harvested in a district originated within that district and divides Naknek-Kvichak District catch to Naknek and Kvichak Rivers based on escapement age composition (Stratton 1991). These numbers have been adjusted to include Branch River run.

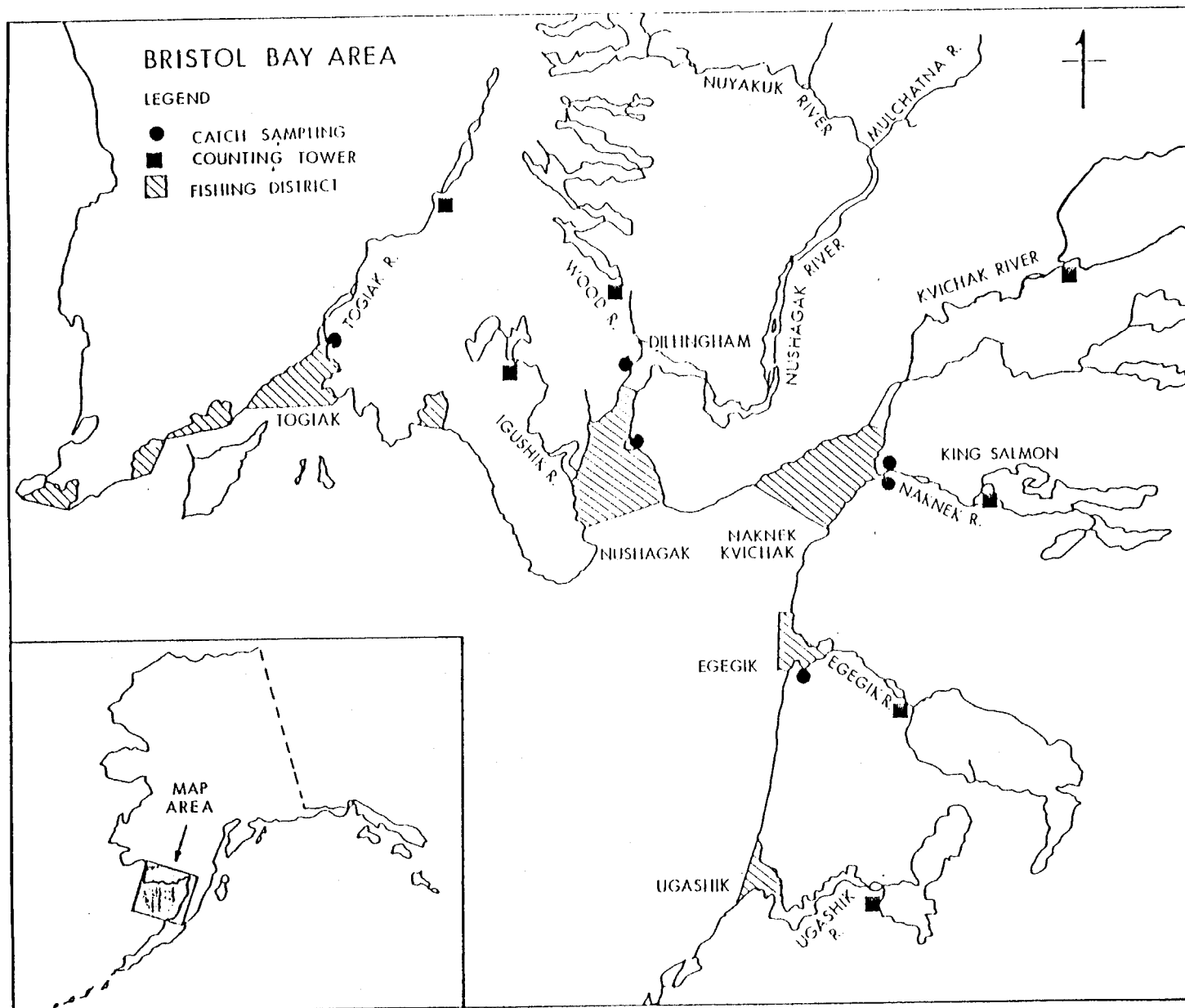


Figure 1. Bristol Bay major river systems and commercial fishing districts.

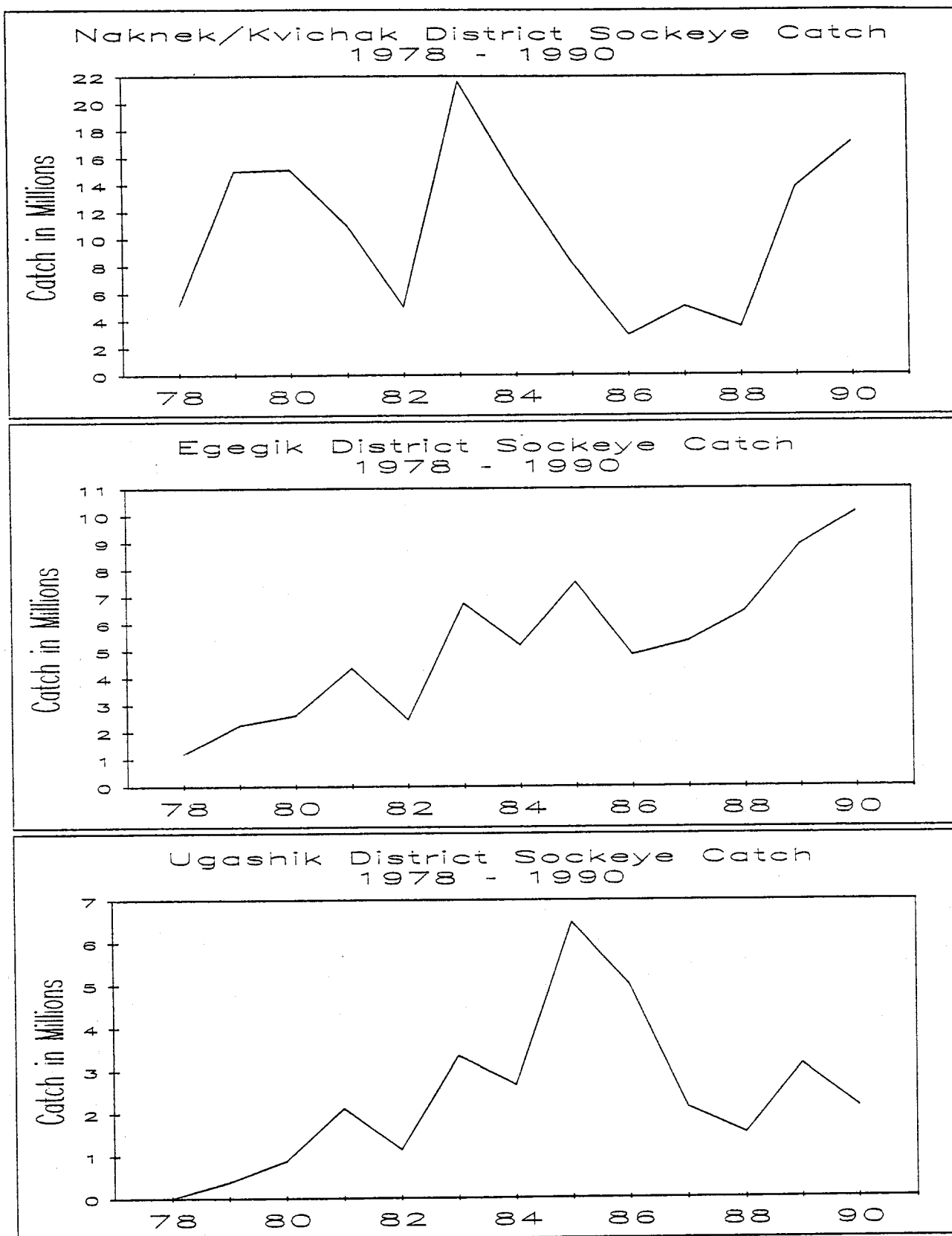


Figure 2. Commercial catch of sockeye salmon in Naknek-Kvichak, Egegik, and Ugashik Districts from 1978 through 1990.

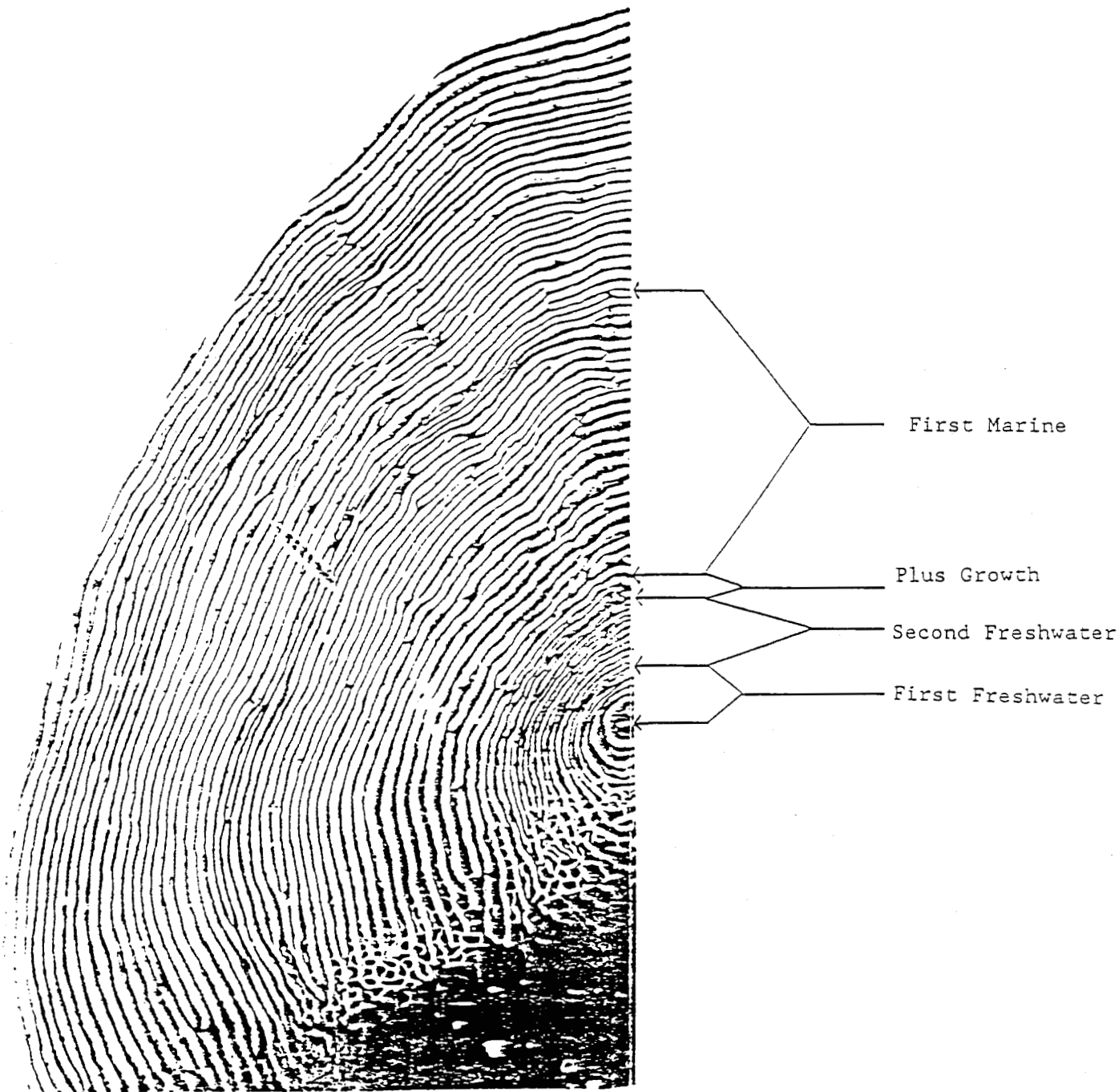


Figure 3. Age-2.2 sockeye salmon scale showing the growth zones measured to generate variables to build linear discriminant functions.

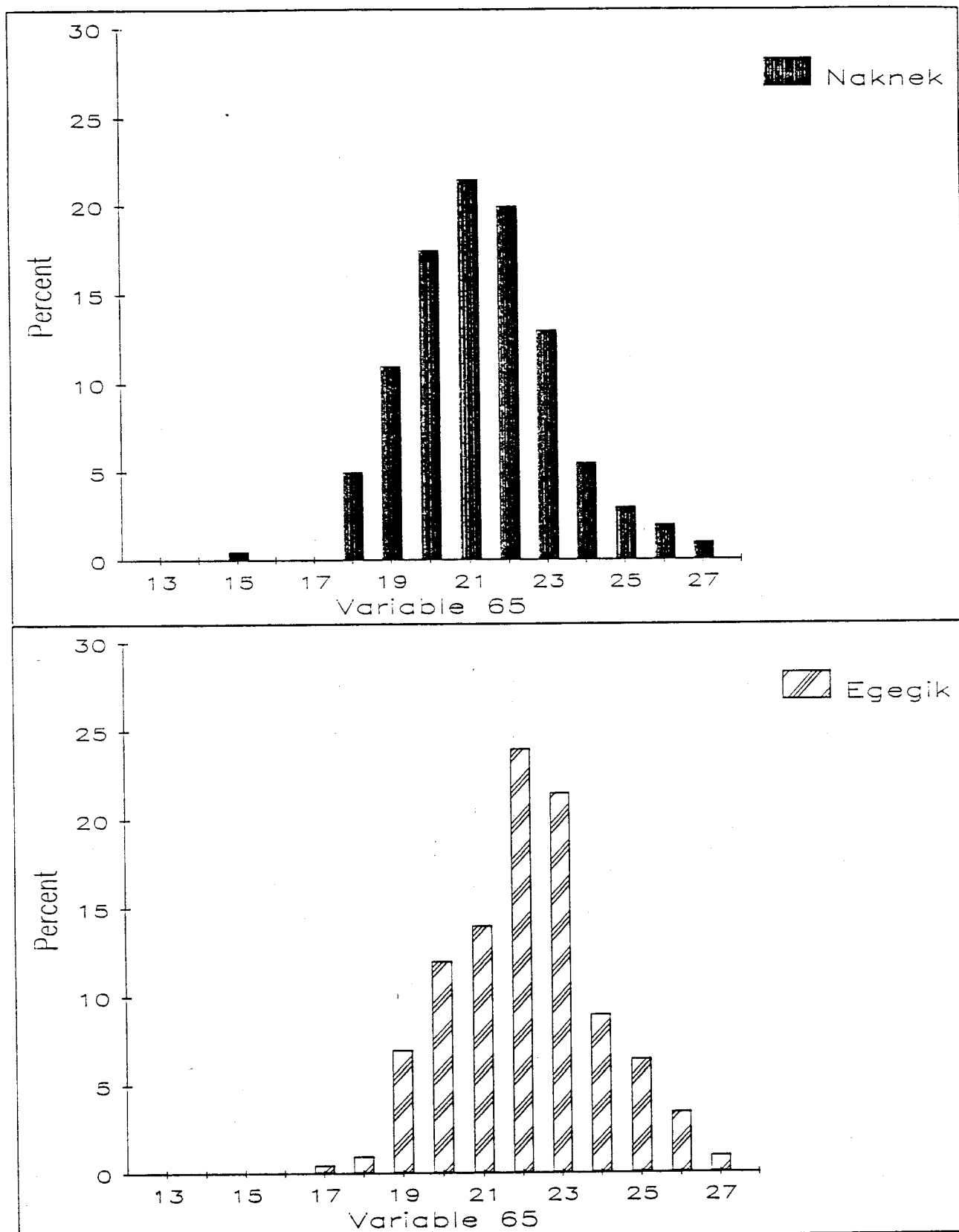


Figure 4. Total number of circuli counted in all freshwater growth zones (NC1FW+NC2FW+NCPG) on age-2.3 sockeye salmon escapement scales, Naknek and Egegik Rivers, 1990.

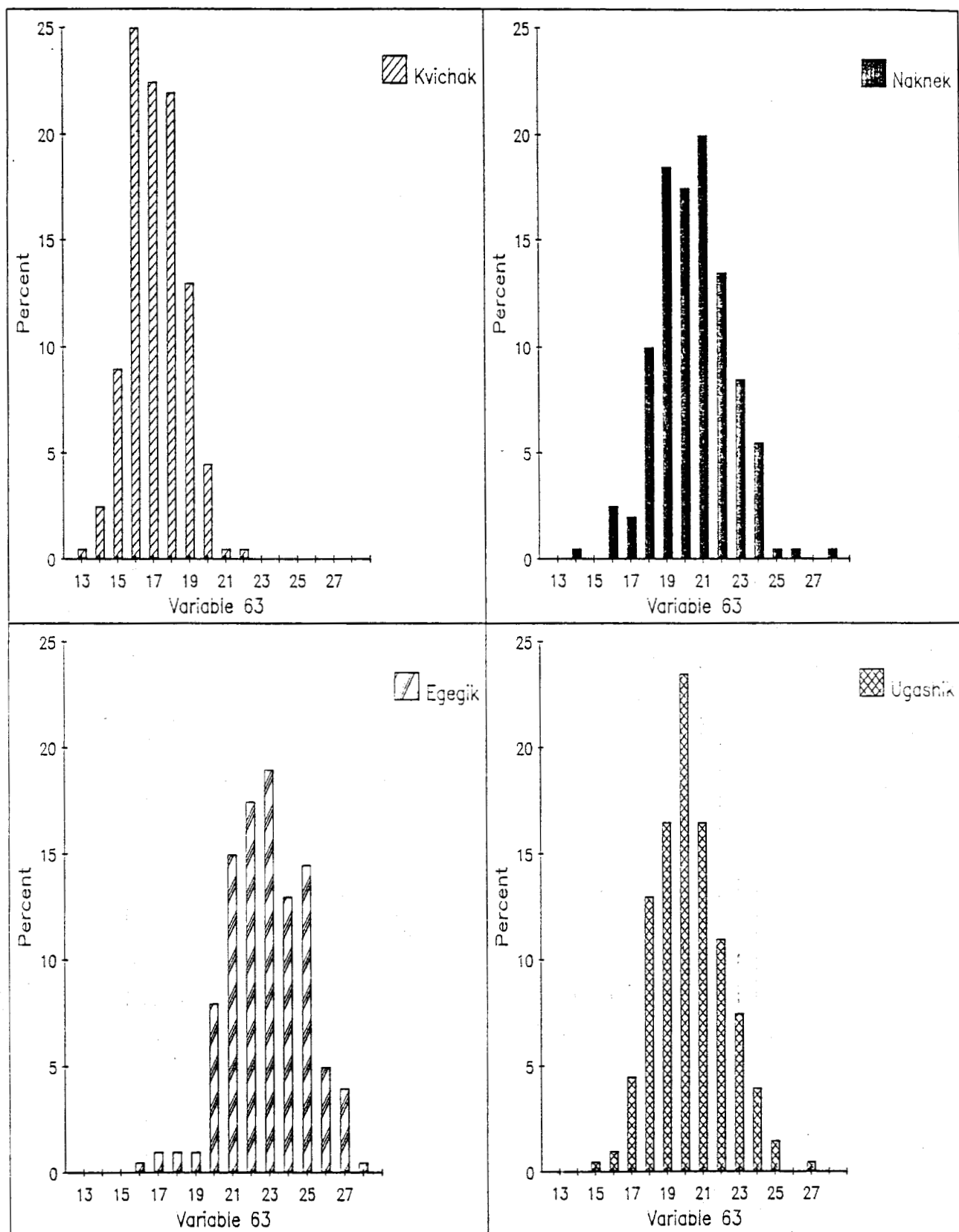


Figure 5. Total number of circuli counted in first and second freshwater growth zones (NC1FW+NC2FW) on age-2.2 sockeye salmon escapement scales, Kvichak, Naknek, Egegik, and Ugashik Rivers, 1990.

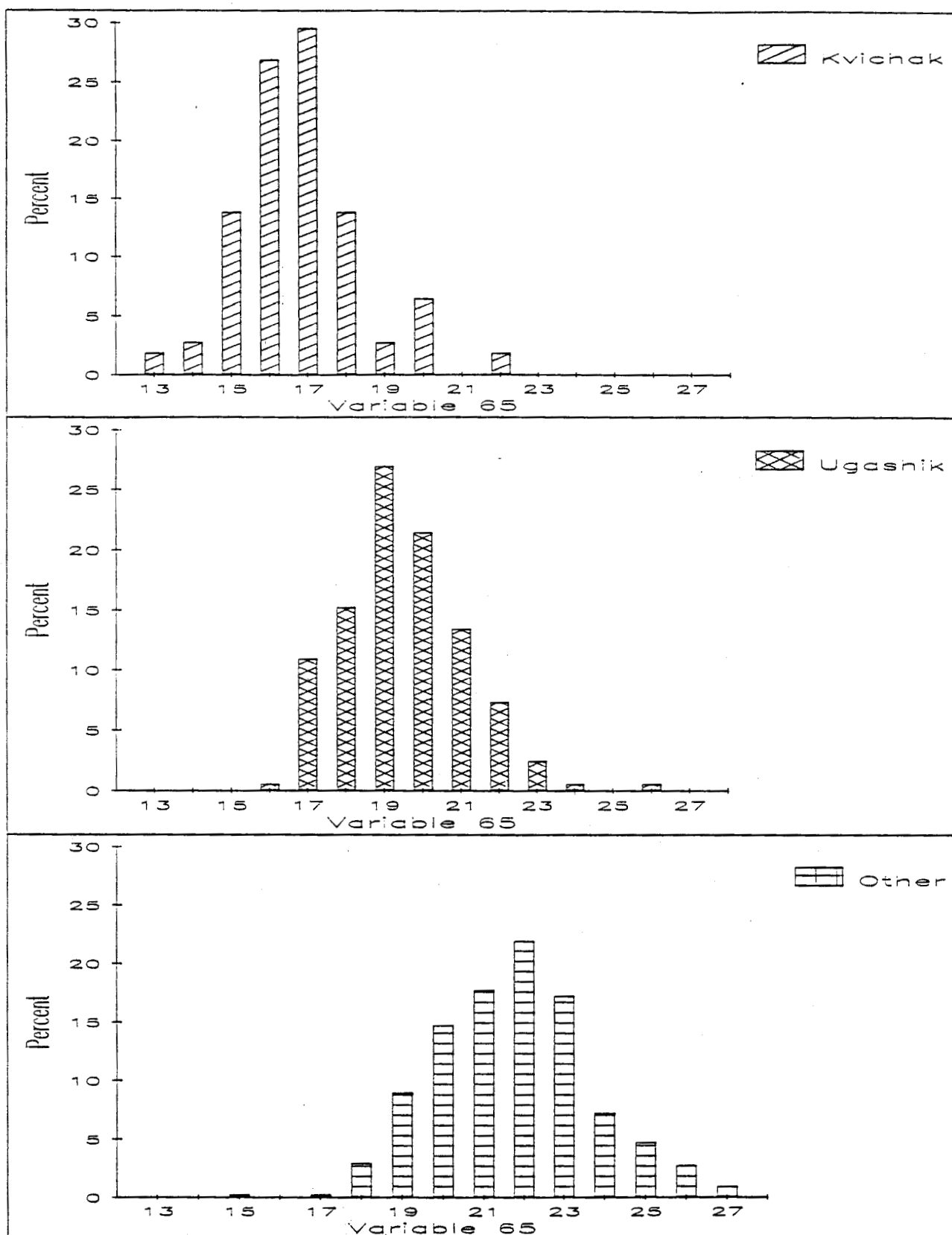
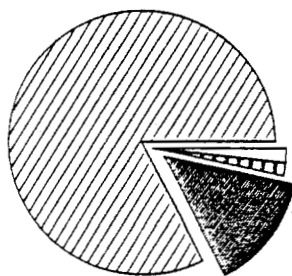


Figure 6. Total number of circuli counted in all freshwater growth zones (NC1FW+NC2FW+NCPG) on age-2.3 sockeye salmon escapement scales, Kvichak, Ugashik, and Naknek/Egegik (Other) Rivers combined, 1990.

1990 Naknek/Kvichak District Age-2.2 Catch



Total Age-2.2 Catch = 7,702,820

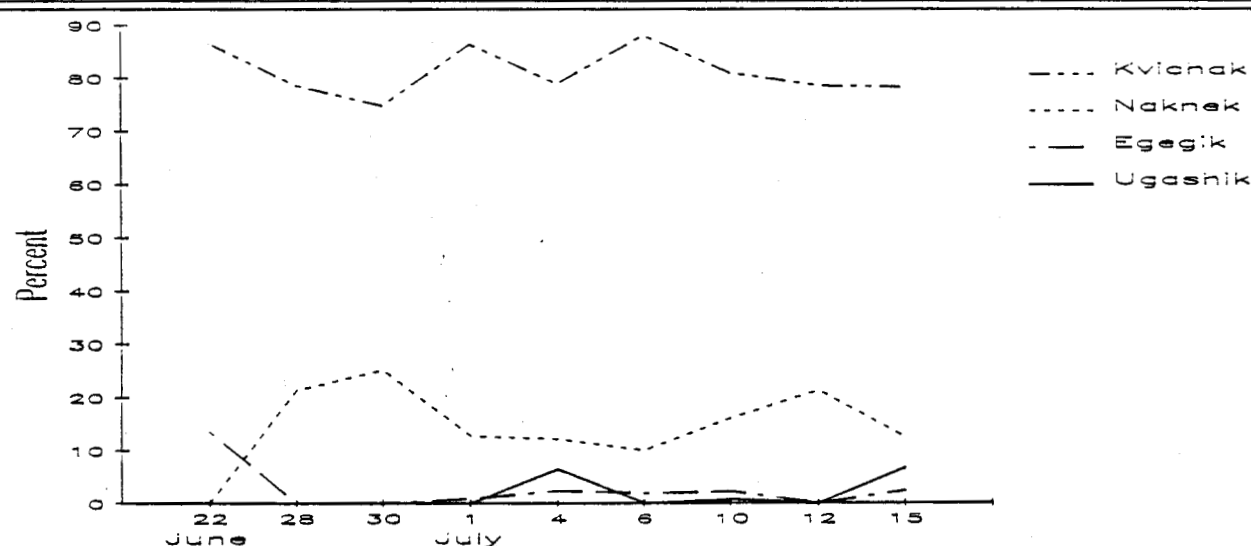
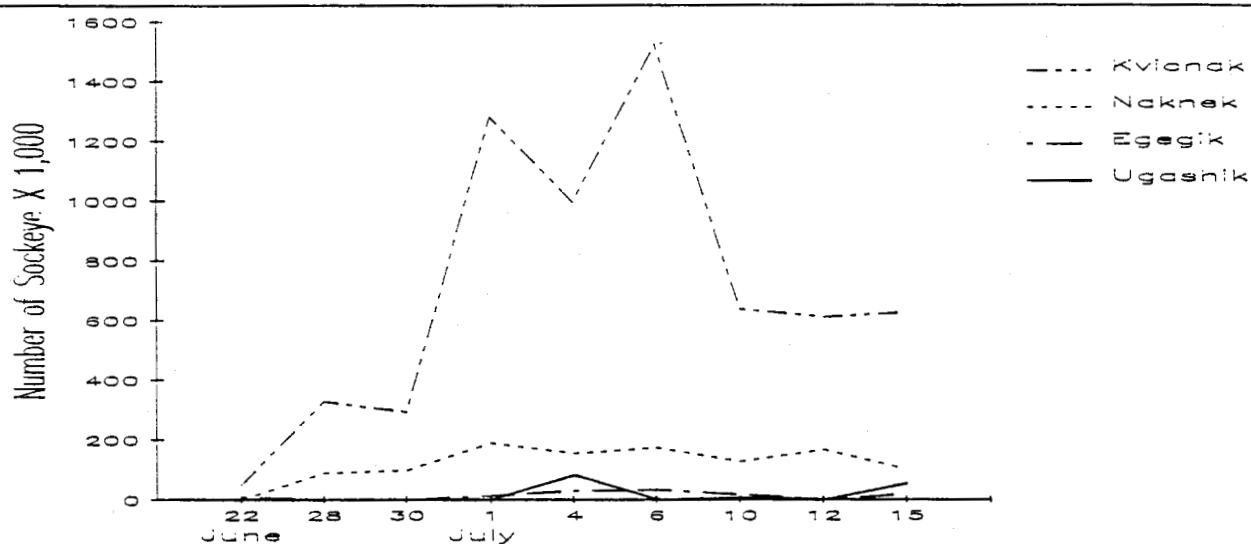
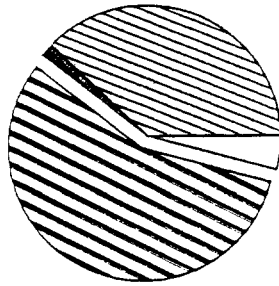


Figure 7. Stock composition estimates for 1990 Naknek-Kvichak District age-2.2 sockeye salmon catch in percent and numbers through time.

1990 Egegik District Age-2.2 Catch



-  Kvichak 37.6%
-  Naknek 1.6%
-  Egegik 56.6%
-  Ugashik 4.2%

Total Age-2.2 Catch = 3,248,740

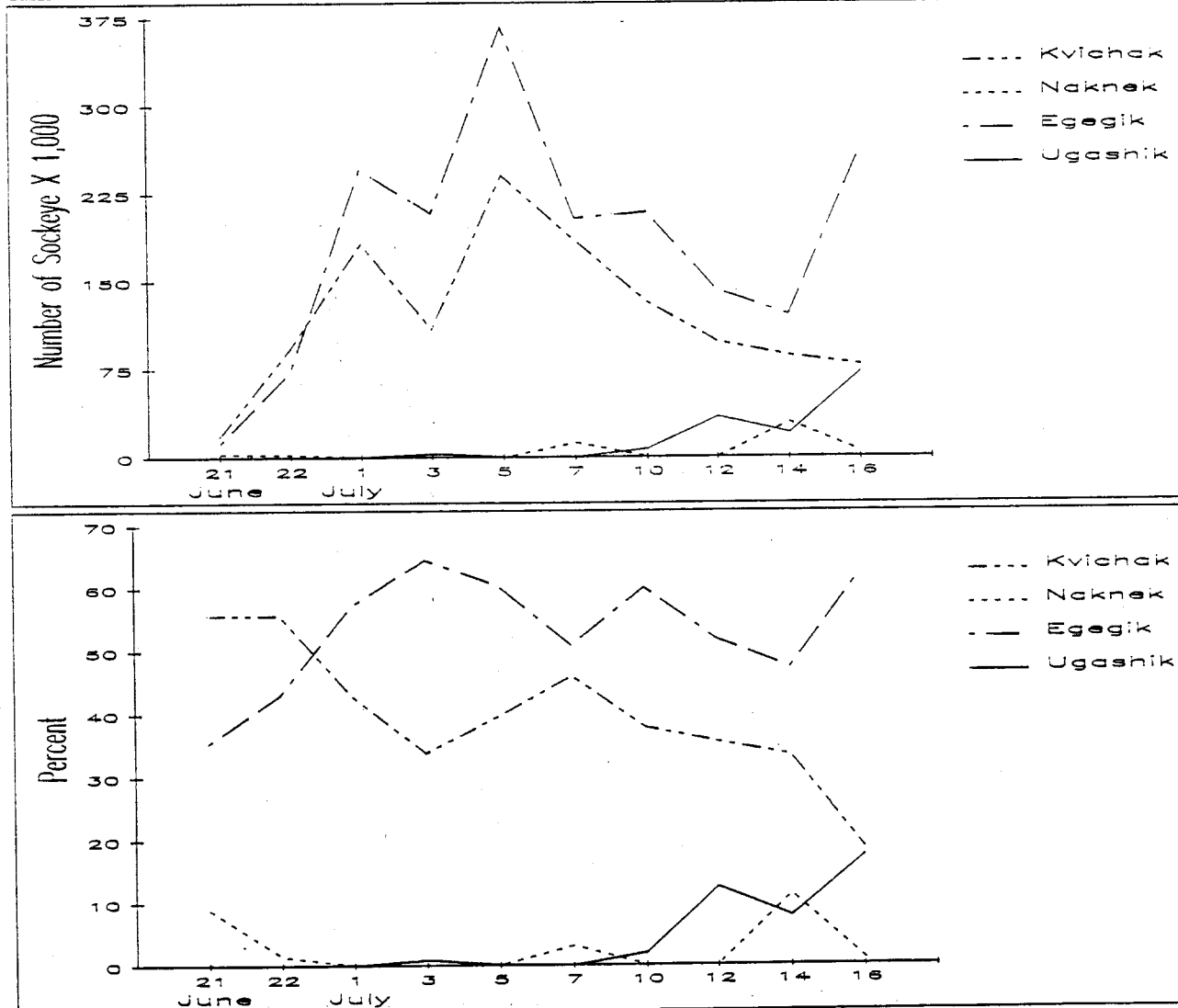
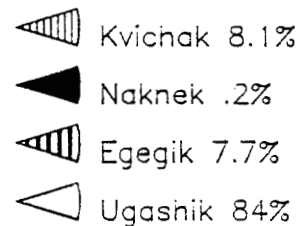
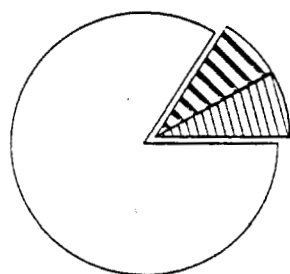


Figure 8. Stock composition estimates for 1990 Egegik District age-2.2 sockeye salmon catch in percent and numbers through time.

1990 Ugashik District Age-2.2 Catch



Total Age-2.2 Catch = 673,465

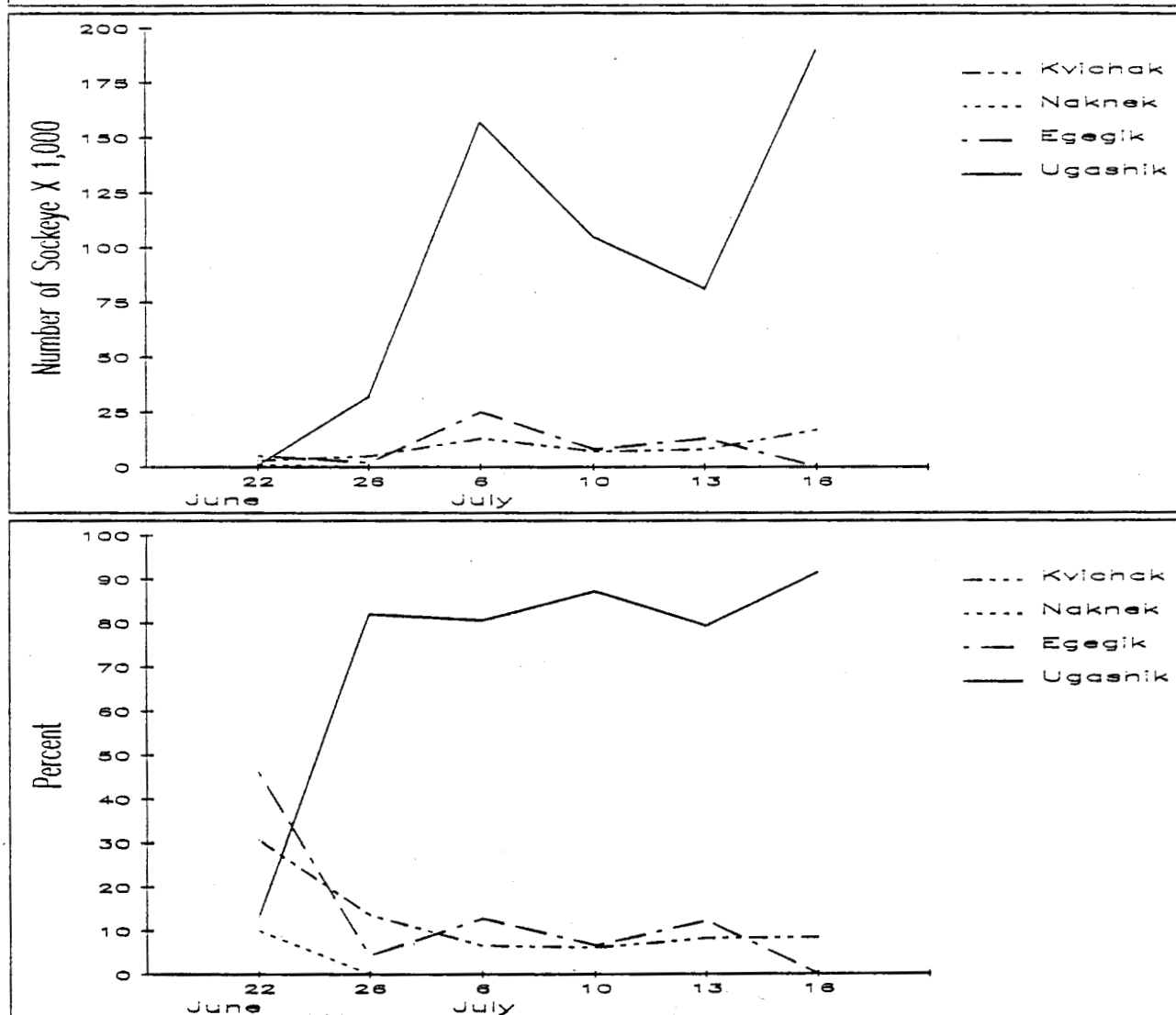
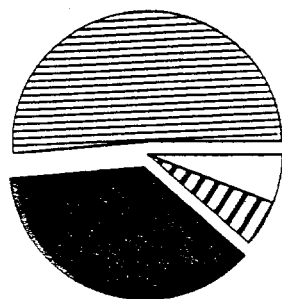


Figure 9. Stock composition estimates for 1990 Ugashik District age-2.2 sockeye salmon catch in percent and numbers through time.

1990 Naknek/Kvichak District Age-2.3 Catch



Total Age-2.3 Catch = 3,491,358

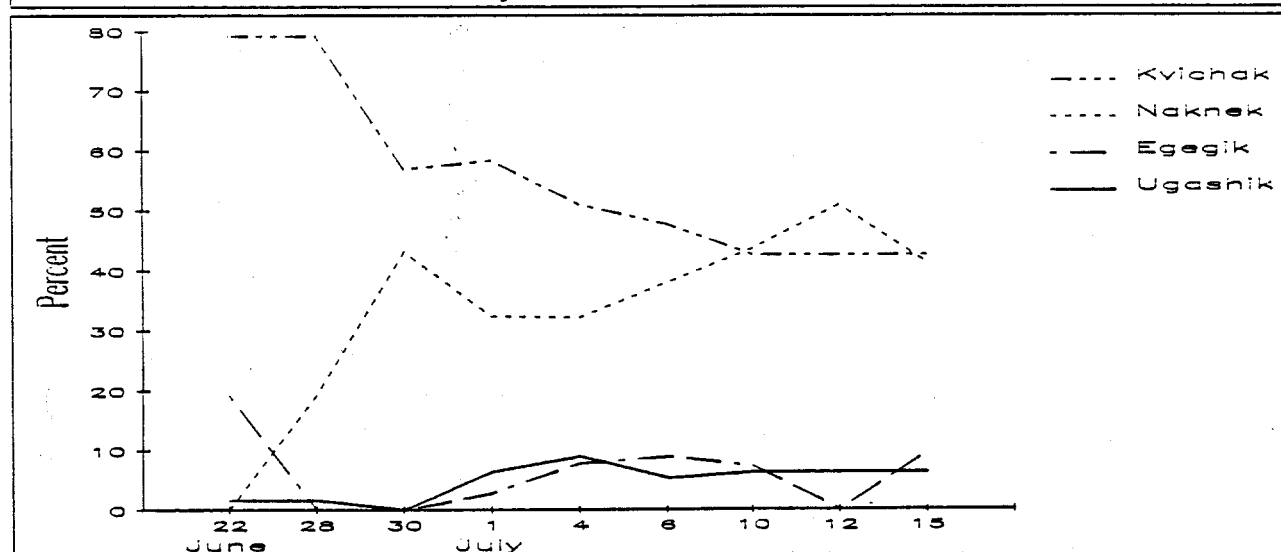
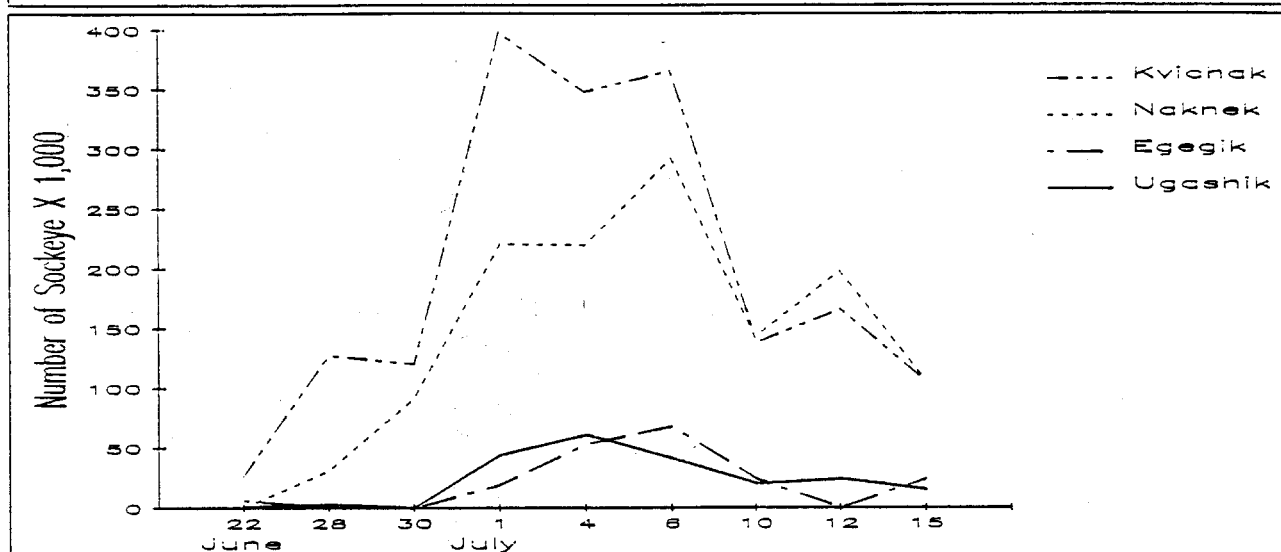
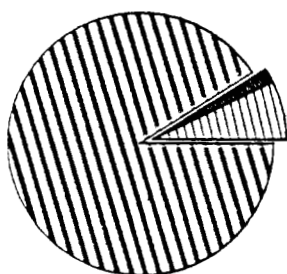


Figure 10. Stock composition estimates for 1990 Naknek-Kvichak District age-2.3 sockeye salmon catch in percent and numbers through time.

1990 Egegik District Age-2.3 Catch



- Kvichak 7.3%
- Naknek 1.8%
- Egegik 90.9%
- Ugashik 0%

Total Age-2.3 Catch = 4,192,760

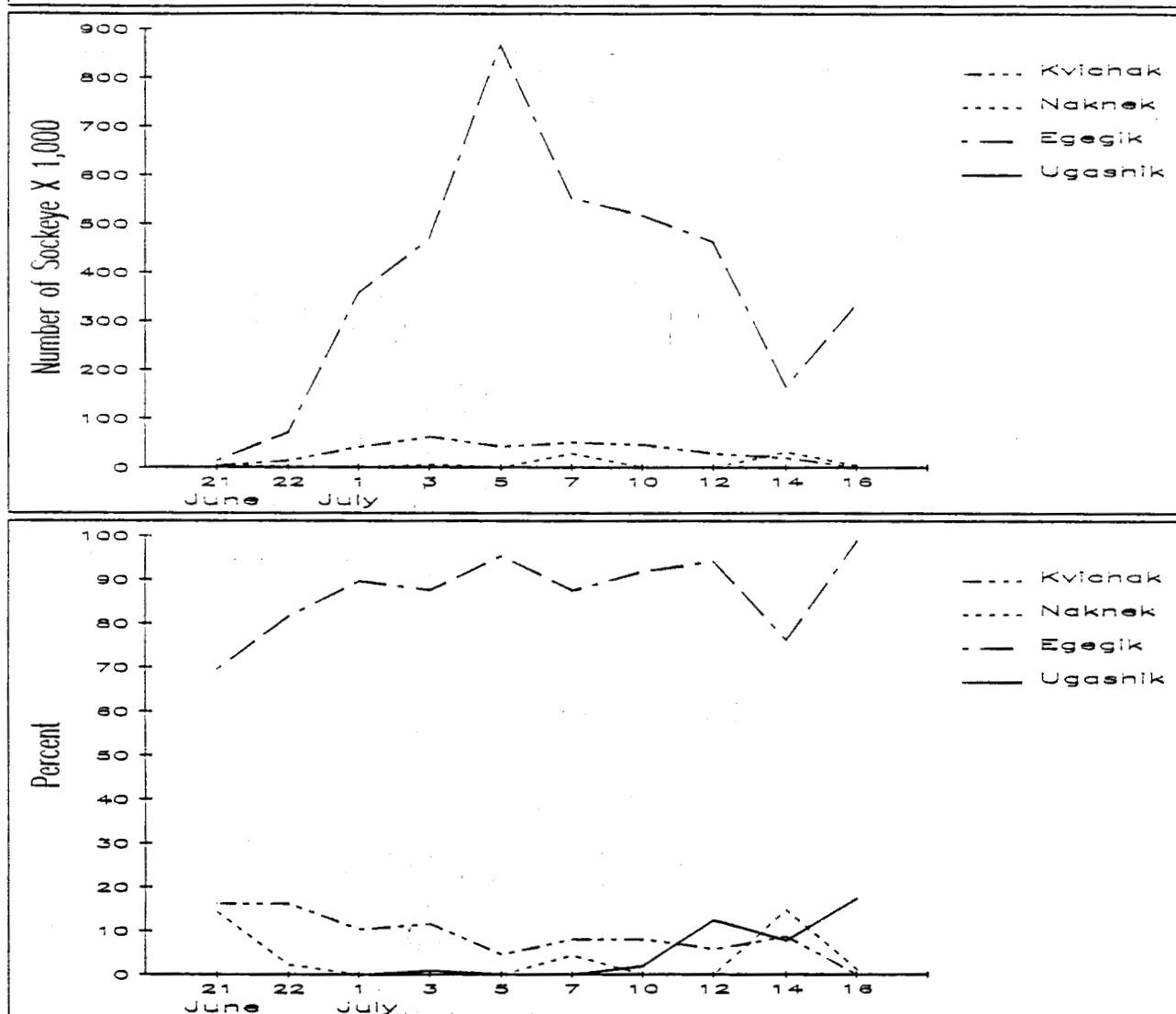
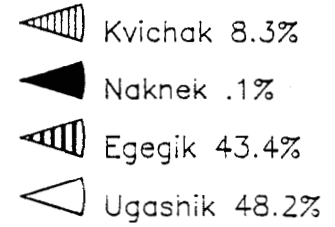
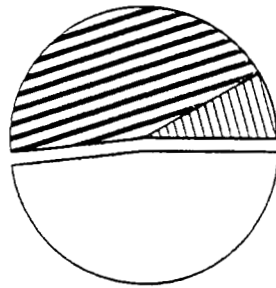


Figure 11. Stock composition estimates for 1990 Egegik District age-2.3 sockeye salmon catch in percent and numbers through time.

1990 Ugashik District Age-2.3 Catch



Total Age-2.3 Catch = 590,690

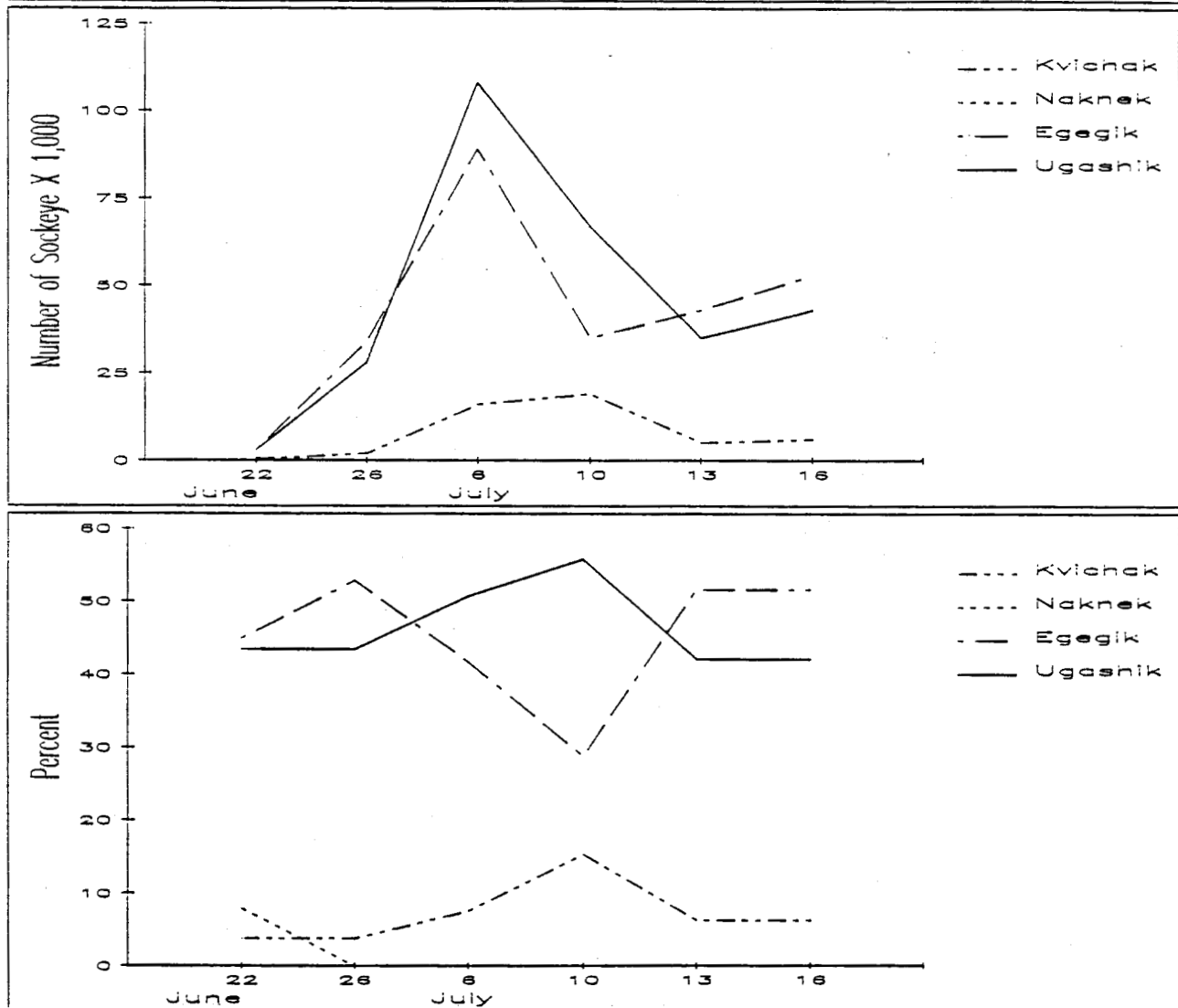
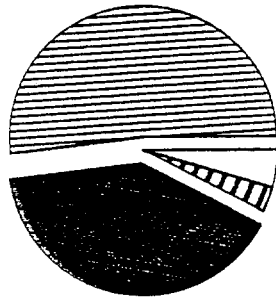


Figure 12. Stock composition estimates for 1990 Ugashik District age-2.3 sockeye salmon catch in percent and numbers through time.

1990 Naknek/Kvichak District Catch



Total Catch = 17,126,625

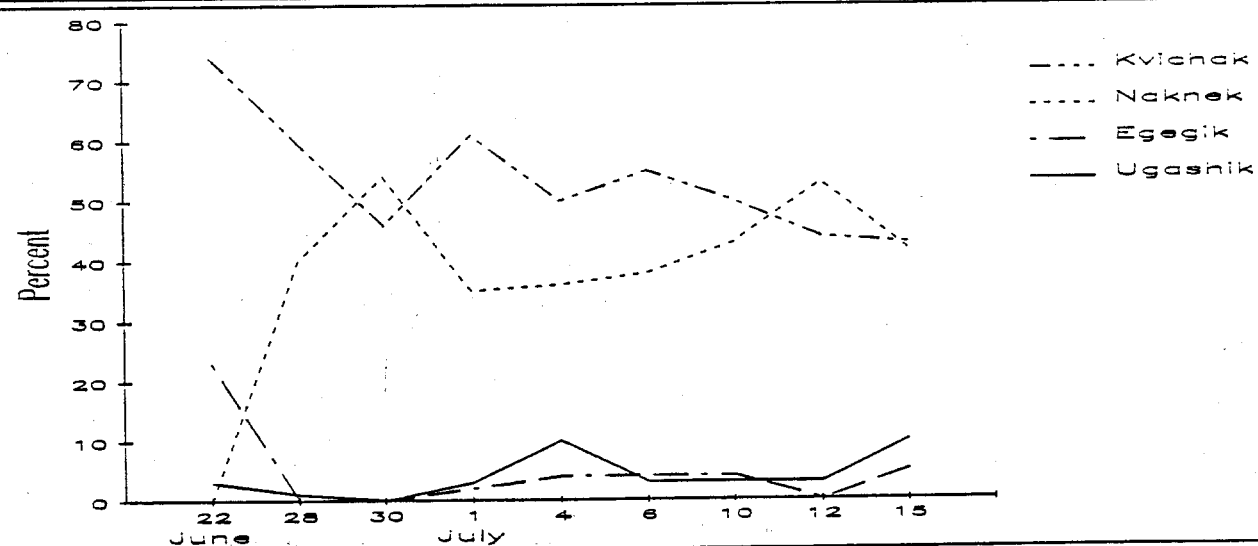
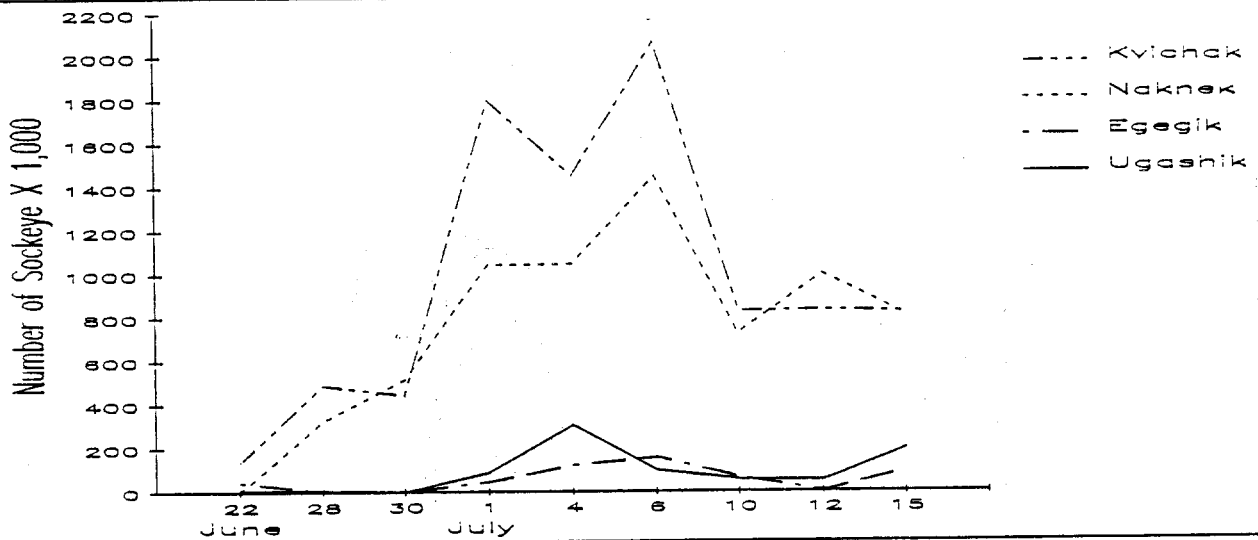
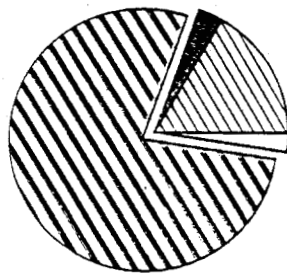


Figure 13. Stock composition estimates for 1990 Naknek-Kvichak District total sockeye salmon catch in percent and numbers through time.

1990 Egegik District Catch



Total Catch = 10,086,953

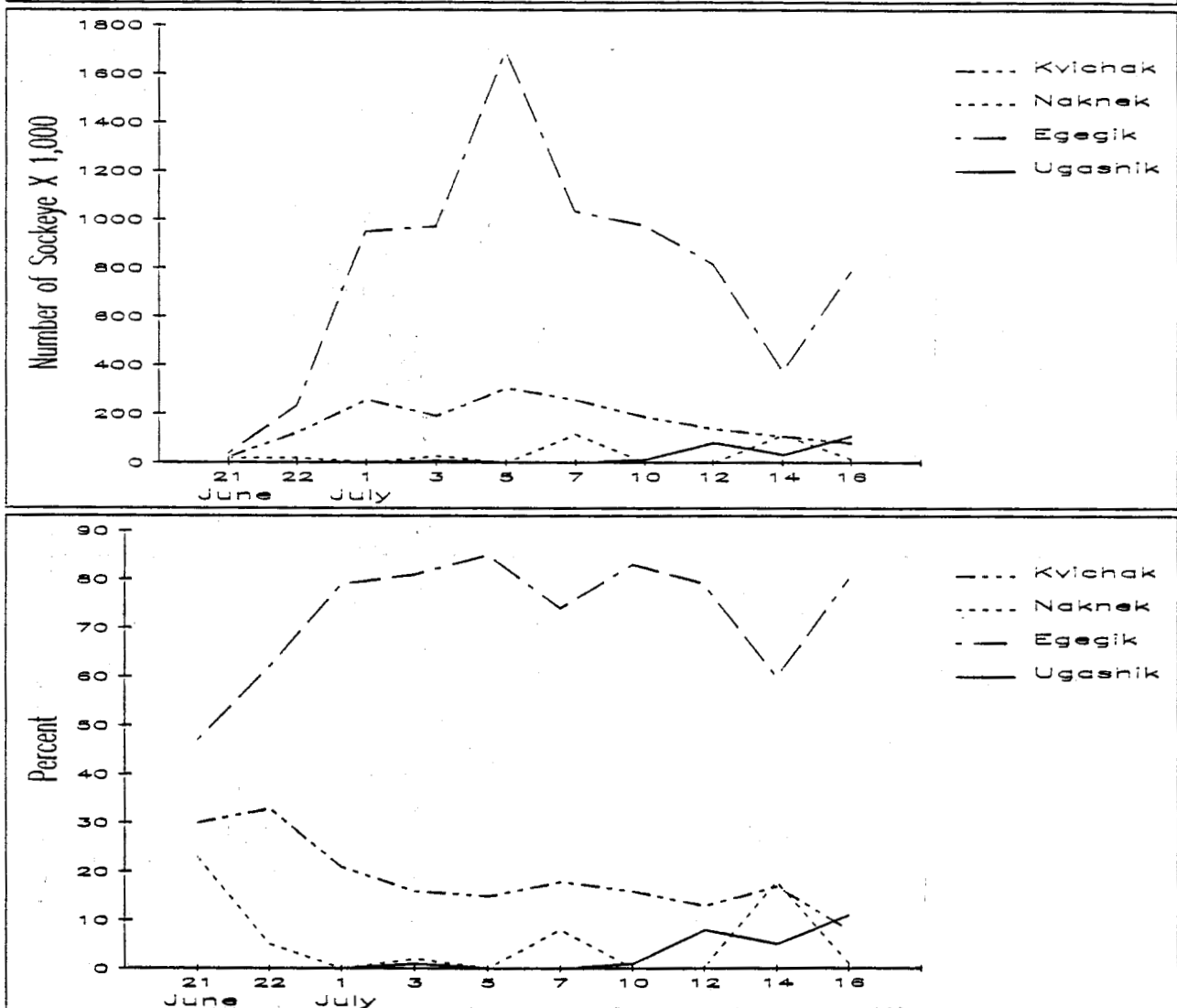
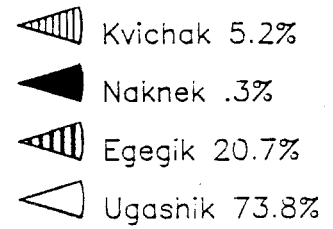
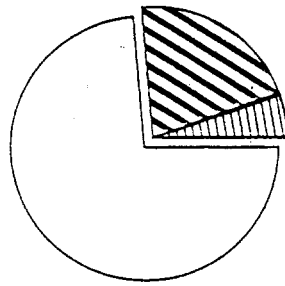


Figure 14. Stock composition estimates for 1990 Egegik District total sockeye salmon catch in percent and numbers through time.

1990 Ugashik District Catch



Total Catch = 2,144,268

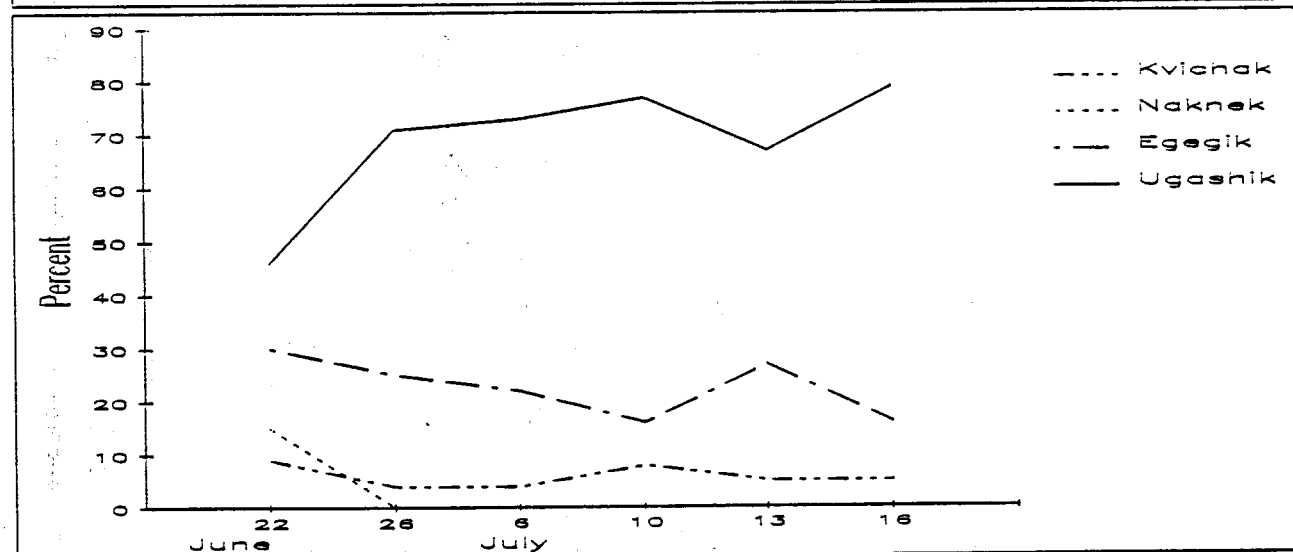
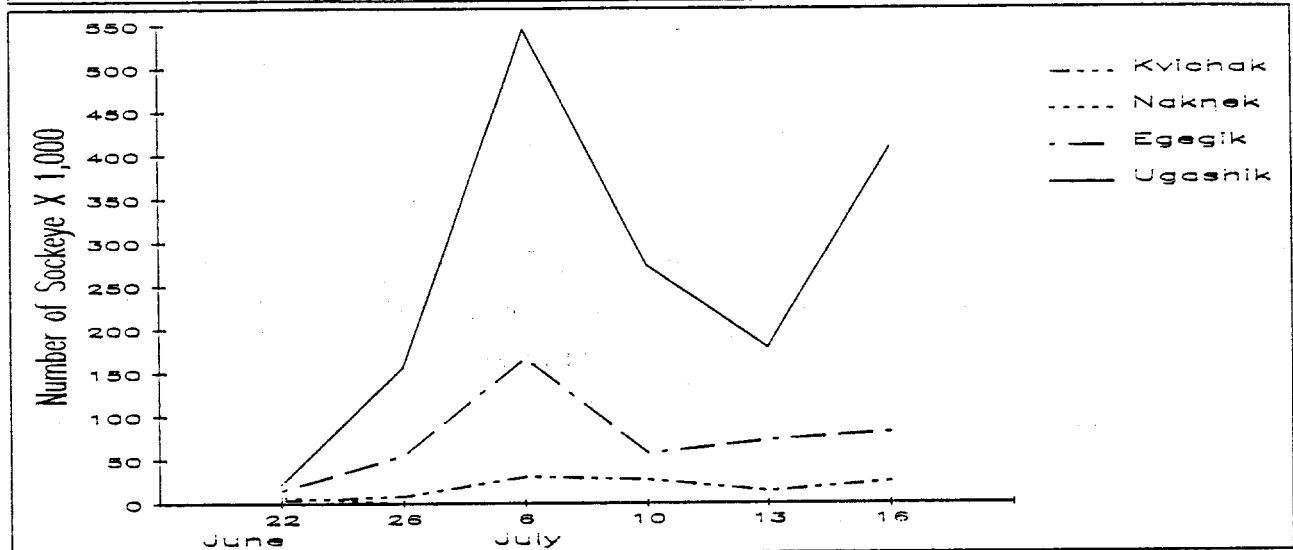
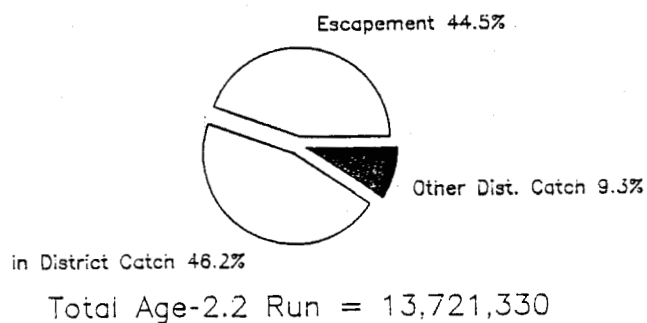
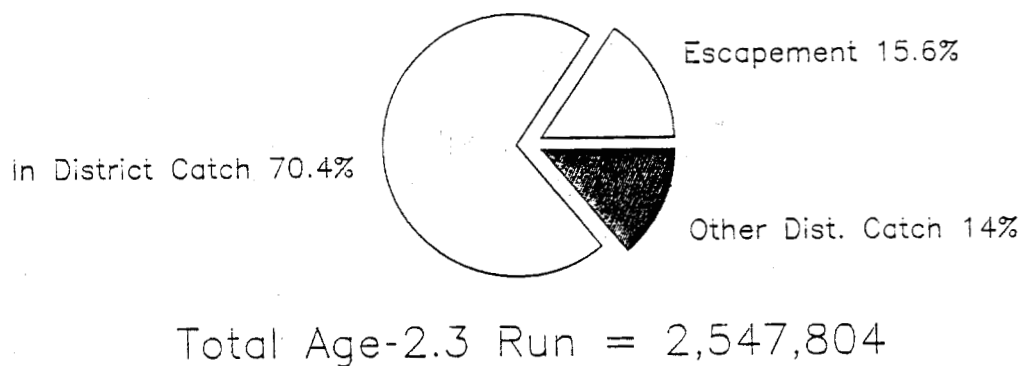


Figure 15. Stock composition estimates for 1990 Ugashik District total sockeye salmon catch in percent and numbers through time.

1990 Kvichak River Age-2.2 Run



1990 Kvichak River Age-2.3 Run



1990 Kvichak River Total Run

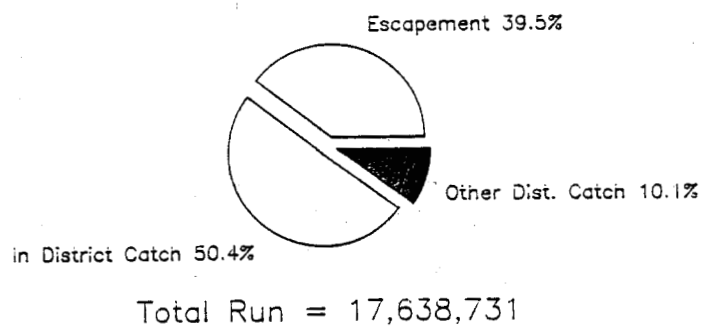
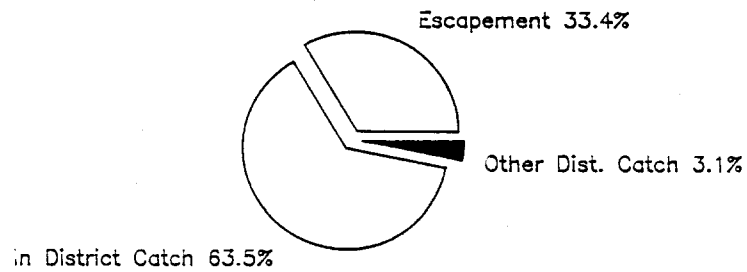


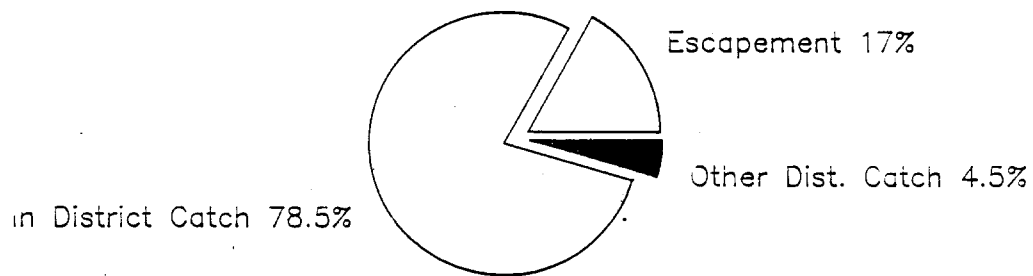
Figure 16. Estimated 1990 Kvichak River sockeye salmon run (by age and total) by escapement, in district catch, and other district catch.

1990 Naknek River Age-2.2 Run



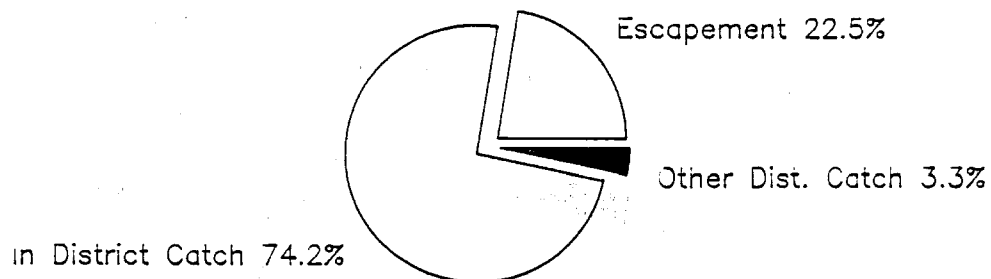
Total Age-2.2 Run = 1,728,185

1990 Naknek River Age-2.3 Run



Total Age-2.3 Run = 1,651,039

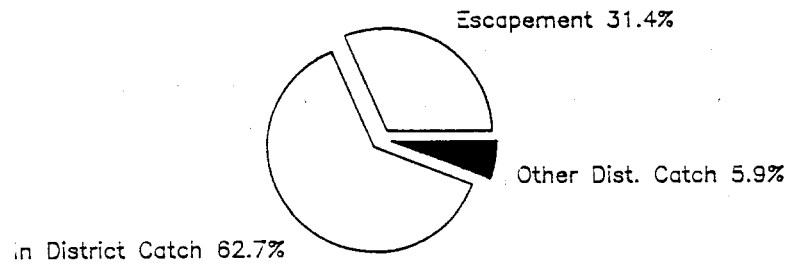
1990 Naknek River Total Run



Total Run = 9,317,105

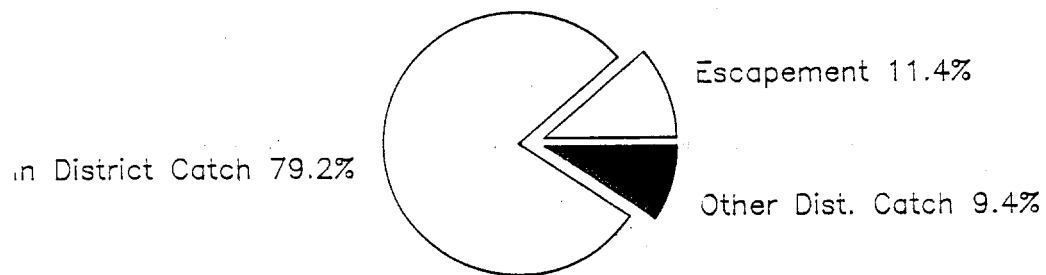
Figure 17. Estimated 1990 Naknek River sockeye salmon run (by age and total) by escapement, in district catch, and other district catch.

1990 Egegik River Age-2.2 Run



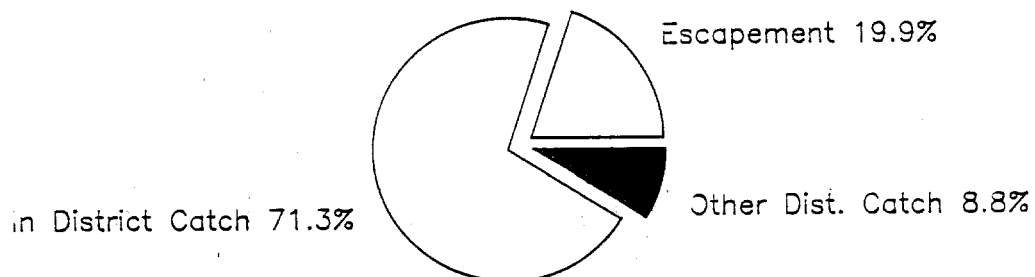
Total Age-2.2 Run = 2,930,942

1990 Egegik River Age-2.3 Run



Total Age-2.3 Run = 4,809,870

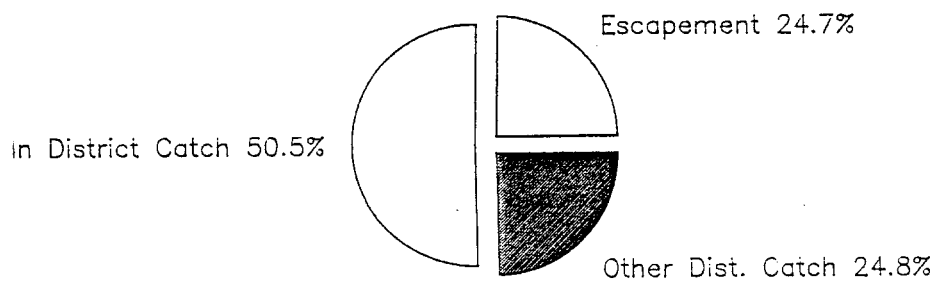
1990 Egegik River Total Run



Total Run = 11,031,214

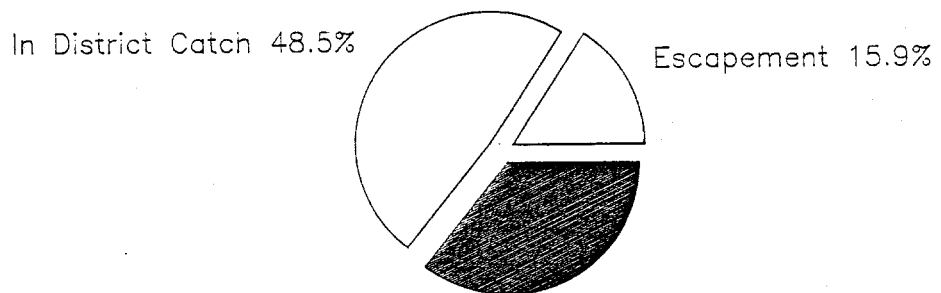
Figure 18. Estimated 1990 Egegik River sockeye salmon run (by age and total) by escapement, in district catch, and other district catch.

1990 Ugashik River Age-2.2 Run



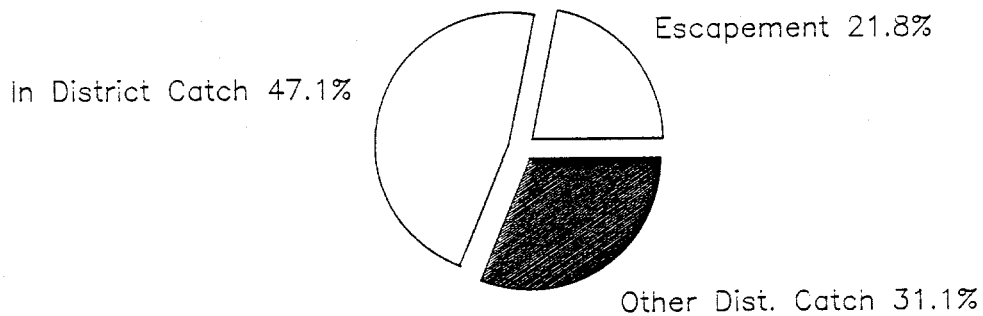
Total Age-2.2 Run = 1,119,059

1990 Ugashik River Age-2.3 Run



Total Age-2.3 Run = 587,129

1990 Ugashik River Total Run



Total Run = 3,354,794

Figure 19. Estimated 1990 Ugashik River sockeye salmon run (by age and total) by escapement, in district catch, and other district catch.

Appendix A.1. Comparison of stock composition estimates of sockeye salmon caught in Naknek-Kvichak District and Naknek Section only openings, 1990.

Date	Percent Classification by Stock				Total
	Kvichak	Naknek	Egegik	Ugashik	
6/11-6/22 ^a	74.2	0.0	22.4	3.4	100.0
6/28-6/29	60.2	39.2	0.0	0.6	100.0
6/30 ^b	46.5	53.5	0.0	0.0	100.0
7/01	68.0	29.9	0.0	2.1	100.0
7/02 ^b	61.2	19.9	12.8	6.1	100.0
7/03	56.9	35.3	4.9	2.9	100.0
7/04 ^b	43.7	37.9	14.1	4.3	100.0
7/05	59.1	28.7	1.4	10.8	100.0
7/06 ^b	48.2	35.2	13.2	3.4	100.0
7/07-7/09	61.4	36.3	0.0	2.3	100.0
7/10-7/11 ^b	50.1	43.0	3.7	3.2	100.0
7/12-7/14	44.7	52.5	0.0	2.8	100.0
7/15-9/01 ^c	43.6	41.3	4.6	10.5	100.0

^a Scale samples were collected 20 and 21 June. Stock composition estimates calculated from those dates were applied to 11 through 22 June catches.

^b Naknek Section only opening

^c Scale samples were collected 15 July. Stock composition estimates calculated from those dates were applied to 15 July through 17 August catches.

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